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#### RESEARCH ARTICLE

#### LUMINESCENCE WILEY

# Intensity enhancement of photoluminescence in $Tb^{3+}/Eu^{3+}$ co-doped $Ca_{14}Zn_6Al_{10}O_{35}$ phosphor for WLEDs

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#### Abstract

This article focuses on the effect of monovalent cation doping on the optical properties of rare earth (RE = Eu<sup>3+</sup>, Tb<sup>3+</sup>) co-doped Ca<sub>14</sub>Zn<sub>6</sub>Al<sub>10</sub>O<sub>35</sub> which has been synthesized by a low temperature combustion method. Crystalline phase of the Ca<sub>14</sub>Zn<sub>6</sub>Al<sub>10</sub>O<sub>35</sub> phosphor was examined and confirmed by X-ray diffraction measurement. Under near-ultraviolet light excitation Eu<sup>3+</sup>-doped Ca<sub>14</sub>Zn<sub>6</sub>Al<sub>10</sub>O<sub>35</sub> phosphor exhibit characterization of Eu<sup>3+</sup> emission bands that are located at a maximum wavelength ( $\lambda_{max}$ ) of approximately 470 nm and other peaks centred at 593 nm and 615 nm, respectively. With Tb<sup>3+</sup>-doped Ca<sub>14</sub>Zn<sub>6</sub>Al<sub>10</sub>O<sub>35</sub> phosphor showing a green emission band centred at 544 nm under near-ultraviolet range. Furthermore, we studied the energy transfer process in Eu<sup>3+</sup>/Tb<sup>3+</sup>pair and enhancement in photoluminescence (PL) intensity with doping different charge compensation. Here we obtained the optimum PL emission intensity of the phosphor in broad and intense visible spectral range which may be significant for the fabrication of white light emitting diodes (WLEDs).

#### KEYWORDS

charge compensation, energy transfer, luminescence, rare earth, WLEDs

#### 1 | INTRODUCTION

Over the last several decades, luminescent lanthanide ions have gained attention owing to their exceptional emissions and luminescence characteristics.<sup>[1]</sup> The rare-earth (RE) elements which show luminescence properties have been extensively used in many displays, lasers, lighting, anti-counterfeiting applications, biosensors, fibre amplifiers, optical thermometry, etc.<sup>[2-6]</sup> At present, white light emitting diodes (WLEDs) have become the conventional lighting source in different fields because of their advantages.<sup>[7-13]</sup> However, the performance of the available green and blue emitting phosphors is substantially higher than that of the currently utilized  $Y_2O_2S:Eu^{3+}$  red phosphor.<sup>[14,15]</sup> Moreover, the red phosphor becomes chemically unstable when exposed to ultraviolet (UV) light; As a result, its lifespan is considerably decreased. A different way to make white light is to use a blue chip to activate a yellow-emitting phosphor, which produces yellow light, which is then mixed with unabsorbed blue light to make white light. Despite this, because of the lack of red-light emission, this approach produces a poor colour rendering index and a low colour temperature. Therefore, the creation of unique white light phosphors having red emission must be extremely effective and durable.<sup>[16-18]</sup> Europium ion (Eu<sup>3+</sup>) must choose a suitable host matrix in order to increase luminescent intensity due to the ions having poor absorption characteristics in the UV and blue areas. Possiblly with the efficient energy transfer phenomenon the emission colour tuned because of the large energy gap between levels.<sup>[19,20]</sup> In the proposed study, Tb<sup>3+</sup>/Eu<sup>3+</sup> activated/co-activated Ca<sub>14</sub>Zn<sub>6</sub>Al<sub>10</sub>O<sub>35</sub> white light emitting phosphor have been reported. Furthermore, the emission intensity was increased by the incorporation of the alkali monovalent ion M (K<sup>+</sup>, Na<sup>+</sup>, Li<sup>+</sup>). Among the alkali monovalent M ions (K<sup>+</sup>, Na<sup>+</sup>, Li<sup>+</sup>), the best charge compensator was reported. The proposed phosphor Ca14Zn6Al10O35 is one of the few phosphor materials that covers J Mater Sci: Mater Electron (2023)34:707



# Luminescence properties of LaPO<sub>4</sub>:RE (RE = $Dy^{3+}$ , $Eu^{3+}$ , $Sm^{3+}$ ) orthophosphate phosphor for n-UV solidstate lighting prepared by wet chemical synthesis

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#### ABSTRACT

The synthesis of LaPO<sub>4</sub>:RE (RE = Dy<sup>3+</sup>, Eu<sup>3+</sup>, Sm<sup>3+</sup>) via a wet chemical method was reported. The prepared phosphor was characterized by XRD, and photoluminescence characteristics were reported. A monoclinic phase was confirmed by X-ray diffraction measurements. Under UV excitation (349 nm), LaPO<sub>4</sub>:Dy<sup>3+</sup> phosphor shows emission at 481 and 575 nm, corresponding to a magnetic dipole ( ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$ ) and electric dipole ( ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$ ) transitions. When LaPO<sub>4</sub>:Eu<sup>3+</sup> phosphor was stimulated at 394 nm, observed emission spectra exhibited prominent bands at 593 and 615 nm, corresponding to magnetic dipole  ${}^{5}D_{0} \rightarrow {}^{7}F_{1}$  transition with the maximum intensity of emission and electric dipole  ${}^{5}D_{0} \rightarrow {}^{7}F_{2}$  transition, respectively. When excited at a wavelength of 402 nm, the LaPO<sub>4</sub>:Sm<sup>3+</sup> phosphor shows emission at 562 nm and 597 nm, which correspond to the  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{7/2}$  transitions. The photoluminescence studies show that the LaPO<sub>4</sub>:RE (RE = Dy<sup>3+</sup>, Eu<sup>3+</sup> and Sm<sup>3+</sup>) phosphors could be applicable in the fields of n-UV-excited solid-state lighting.

#### 1 Introduction

The most likely solid-state lighting technology that might replace traditional incandescent and fluorescent bulbs is w-LEDs [1–3] owing to their high efficiency, good stability and fast response along with their power and eco-friendly benefits. The property of high boiling point, low solubility in water, as well as stability to high temperature LaPO<sub>4</sub> phosphor is also good as we have discussed in that sample.

https://doi.org/10.1007/s10854-023-10119-0 Published online: 07 March 2023 Because of their high boiling point, chemical stability and good lighting yields of the doping concentration, LaPO<sub>4</sub> and its mixtures are good hosts as extremely effective emitters of fluorescent light [4]. The significant absorption of  $PO_4^{3-}$  in the VUV region was found in GdPO<sub>4</sub>:Eu [5]. However, the greatest emission of Eu<sup>3+</sup>-doped LaPO<sub>4</sub> occurs during VUV stimulation in the orange light band [6]. As a result, enhancing the colour purity of LaPO<sub>4</sub>:Eu<sup>3+</sup> becomes important.

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#### **RESEARCH ARTICLE**



#### Wet chemical synthesis and photoluminescence properties of NaSrPO<sub>4</sub>:Dy<sup>3+</sup> and NaSrPO<sub>4</sub>:Eu<sup>3+</sup> phosphors for near UV-based w-LEDs

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**Abstract** The NaSrPO<sub>4</sub>:Dy<sup>3+</sup>and NaSrPO<sub>4</sub>:Eu<sup>3+</sup>phosphors were synthesized with success via wet chemical synthesis. XRD and photoluminescence properties of the prepared phosphors were thoroughly investigated. The XRD was used to confirm the hexagonal phase with P6<sub>3</sub>/mmc (194) space group. The emission peaks of NaSrPO<sub>4</sub>:Dy<sup>3+</sup> phosphor are observed at 484 and 574 nm under excitation at 350 nm. When NaSrPO<sub>4</sub>:Eu<sup>3+</sup> phosphor was stimulated at 394 nm, the emission bands at 591 and 613 nm are found. The CIE coordinates indicate that the present phosphors have high colour purity. The results indicate that NaSrPO<sub>4</sub>:Dy<sup>3+</sup> and NaSrPO<sub>4</sub>:Eu<sup>3+</sup> phosphors were blue-yellow and orange-red emitting under n-UV converting w-LEDs.

Keyword Wet chemical synthesis  $\cdot$  XRD  $\cdot$  Phosphor  $\cdot$  Photoluminescence  $\cdot$  w-LED

#### Introduction

It is widely acknowledged that the invention of w-LEDs in this century has resulted in a significant revolution in illumination techniques due to their excellent properties such as luminous quality, energy saving, excellent stability,

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high efficiency and environmental friendliness [1–4]. Blue, green and red phosphors have been studied for application in w-LEDs [5–8]. Phosphors are an important material in lighting technology and have received a lot of attention in phosphor converted w-LEDs [9, 10]. As a result, it is important to discover new white phosphors with enhanced brightness, which originate from a single phosphor.

The most popular technique for creating w-LEDs was developed by S. Nakamura et al. in 1997 [11], combining both the blue-based InGaN LED (light-emitting diode) chip and the yellow-emitting (yttrium aluminium garnet) YAG:Ce<sup>3+</sup> phosphors. A poor colour executing index (CRI, Ra 7000 K) brought due to the absence of a red component and significant thermal quenching are two shortcomings of the pc-w-LEDs previously discussed [12, 13]. Extraordinary rare earth-doped inorganic phosphors are entrancing and have been generally investigated through ongoing numerous years. In this particular circumstance, the uncommon superior properties of trivalent ions doped phosphate materials of the type ABPO<sub>4</sub>, where A and B are monovalent and divalent cations, independently, have drawn a lot of interest [14]. To determine these issues, single-part white lightcommunicating phosphors have procured pervasiveness due to their high brilliance efficiency, assortment reproducibility and modest collecting costs [15, 16].

The Dy<sup>3+</sup> ion has two primary emission groups: blue (470-500 nm) because of the magnetic dipole  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  transition and yellow (570-600 nm) connected with the touchy electric dipole  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$  transition [17, 18]. Orthophosphate is regarded as an important host for luminescent materials due to its excellent properties, which include a large band gap and high absorption of PO<sub>4</sub><sup>3-</sup> in the n-UV region, moderate phonon energy, high chemical stability, exceptional optical damage threshold and low sintering temperature. Numerous investigations have been

Chemical Data Collections 43 (2023) 100979



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# **Chemical Data Collections**





Data Article

#### Effect of dopant concentration on luminescence properties of $Ba_3(PO_4)_2$ :RE (RE= Sm<sup>3+</sup>, Eu<sup>3+</sup>, Dy<sup>3+</sup>) phosphor for solid-state lighting



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#### ARTICLE INFO

Keywords: Photoluminescence Wet chemical method Phosphor Rare-earth doped Solid state lighting

#### ABSTRACT

Wet chemical synthesis was used for the first time to make  $Ba_3(PO_4)_2$ : RE (RE= Sm<sup>3+</sup>, Eu<sup>3+</sup>, Dy<sup>3+</sup>) phosphors. The phosphor X-ray diffraction (XRD), structural and photoluminescence characteristics were thoroughly investigated. Under UV excitation 402 nm, the emission spectra of the  $Ba_3(PO_4)_2{:}Sm^{3+}$  phosphors consists emission peaks at 561 nm (yellow) and 598 nm (orange), respectively. When the Ba<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>:Eu<sup>3+</sup> phosphor was excited at 394 nm, the emission spectra exhibited prominent bands at 593 nm (orange) and 614 nm (red). The emission wavelengths of Ba<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>:Dy<sup>3+</sup> phosphor were 474 nm (blue) and 573 nm (yellow), respectively. According to the photoluminescence results,  $Ba_3(PO_4)_2$ :RE (RE = Sm<sup>3+</sup>, Eu<sup>3+</sup> and Dy<sup>3+</sup>) phosphors might be useful in the fields of near UV-excited solid state lighting.

#### **Specifications Table**

Subject area	Luminescence, Material Physics, etc
Compounds	Barium nitrate, ammonium dihydrogen phosphate, samarium oxide, europium oxide and dysprosium oxide and urea.
Data Category	synthesized materials, XRD
Data acquisition	Photoluminescence, X-ray diffraction (XRD),
format	
Data type	Experimental and Analyzed
Procedure	The $\text{Sm}^{3+}$ , $\text{Eu}^{3+}$ and $\text{Dy}^{3+}$ ions doped $\text{Ba}_3(\text{PO}_4)_2$ phosphor were synthesized using a wet chemical technique. The sample preparation was performed with Barium nitrate, dysprosium oxide, europium oxide, ammonium dihydrogen phosphate and samarium oxide. Analytical
	Reagent (AR) grade materials and chemicals are used. The samples should be placed first on the sample weighing and weight box. For the preparation of Ba <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> :Sm <sup>3+</sup> phosphor, raw materials are weighing according to stoichiometry ratio and dissolved separately in distilled
	water in a beaker. By dissolving $Dy_2O_3$ into an HNO <sub>3</sub> solution, dysprosium oxide is converted to dysprosium nitrate. The solutions were then combined in one beaker to produce the desired compound. After 30 minutes of stirring, the sample became transparent, and after 10
	hours of heating at 100°C in a Hot Air Oven, a powder product was obtained. The resulting white powder was crushed into small particles in a pestle and mortar. A similar technique is used for synthesis of $Ba_3(PO_4)_2$ : $Eu^{3+}$ , and $Ba_3(PO_4)_2$ : $Dy^{3+}$ phosphors.
Data accessibility	Within this manuscript.

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# Luminescence properties of BiPO<sub>4</sub>:Ln (Ln = $Dy^{3+}$ , $Tb^{3+}$ and $Sm^{3+}$ ) orthophosphate phosphors for near-UV-based solid-state lighting

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Abstract. The BiPO<sub>4</sub>:Ln (Ln = Dy<sup>3+</sup>, Tb<sup>3+</sup> and Sm<sup>3+</sup>) phosphor were prepared using wet chemical synthesis and studied its photoluminescence properties. Under 352 nm excitation, the BiPO<sub>4</sub>:Dy<sup>3+</sup> phosphor shows the blue (481 nm) and yellow (575 nm) emissions due to the  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  and  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$  transitions of the Dy<sup>3+</sup> ion, respectively. When BiPO<sub>4</sub>:Tb<sup>3+</sup> phosphor was excited at 378 nm, it emits efficient narrow green emission at 545 nm due to  ${}^{5}D_4 \rightarrow {}^{7}F_5$  transition. The BiPO<sub>4</sub>:Sm<sup>3+</sup> phosphor shows yellow, orange and red emissions centred at 598 nm, which is attributed to the  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{1/2}$  transition of the Sm<sup>3+</sup> ion. The CIE coordinates indicate that the prepared phosphors have high colour purity. The photoluminescence results suggests that BiPO<sub>4</sub>:Ln (Ln = Dy<sup>3+</sup>, Tb<sup>3+</sup> and Sm<sup>3+</sup>) phosphor may be used as a possible material for near-UV-based solid-state lighting.

Keywords. Photoluminescence; wet chemical synthesis; phosphor; phosphate; lanthanide doped; solid-state lighting.

#### 1. Introduction

Since the first commercially available white light-emitting diodes (w-LEDs) in 1997 [1,2], they have been widely used for the backlight units (BLUs) of liquid crystal displays (LCDs), traffic signals, and, most notably, solid-state lighting. Because of its long lifetime, high luminescence efficiency, low power consumption and environmental friendliness, solid-state lighting based on GaN or InGaN semiconductors have attracted a lot of attention [3]. Solid-state w-LEDs have garnered major consideration due to their great efficiency as an excellent energy-saving, prospective and eco-friendly choice for general illumination [4]. As a result, one of the most essential problems in the design of luminescent devices for solid-state lighting is the preparation of novel rare-earth-doped phosphors.

Rare-earth phosphors are exciting because of their excellent luminescence capabilities based on 4f–4f or 5d–4f transitions, as well as their wide variety of applications in display devices and solid-state lighting [5]. The current focus in this field is on improving the distinctive luminescent properties of lanthanide-based materials for interdisciplinary research and innovative applications. When phosphors are doped with appropriate auxiliary activators, their luminous performance can be considerably increased. The majority of lanthanides occur in a trivalent form and exhibit distinct optical characteristics.

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Samarium ion is an active ion for several inorganic host lattices and often operates as a potent emitting centre due to its energy level structure and high luminescence efficiency [6].

White LEDs are recognized as a future generation of solid-state lighting technology due to their superior features. White light may be produced in a variety of methods in solid-state lighting by coating appropriate phosphors on LED chips. One method is to combine a blue LED with a yellow phosphor derived from Y<sub>3</sub>Al<sub>5</sub>O<sub>12</sub>:Ce<sup>3+</sup> combining the blue light from the LED with the yellow light from the phosphor results in white light [7]. Although this kind of white light combining technique has been utilized for many years, it still has several severe drawbacks, such as a low colour rendering index (Ra < 80) due to red emission scarcity, a low thermal quenching temperature and a narrow viewable range. Furthermore, when mass-produced, white LEDs based on blue LED chips have low colour reproducibility [8]. To resolve these concerns, another method of producing white light utilizing ultraviolet (UV) light, particularly near-UV (NUV) light, from LED exciting (red/green/blue tri-colour phosphors) has received a lot of interest [9]. Due to their excellent colour rendering index, high colour tolerance and high conversion efficiency into visible light, NUV phosphor-converted LEDs are projected to have various potential uses [10]. As a result, considerable emphasis has been placed on the development of new RGB

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# Synthesis and photoluminescence characteristics of Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>4</sub>:Dy<sup>3+</sup> phosphors for n-UV based solid-state lighting



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#### ARTICLE INFO

Keywords: Phosphor Solid state lighting Wet chemical method Luminescence

#### ABSTRACT

A series of  $Ba_2Ca(PO_4)_4:Dy^{3+}$  phosphors were synthesized by the wet chemical method and the photoluminescence properties were systematically investigated. Under the 350 nm near ultraviolet excitation,  $Ba_2Ca$  $(PO_4)_4:Dy^{3+}$  phosphor shows emission peak at 475 nm (blue) and 572 nm (yellow). At 0.5 mol% of  $Dy^{3+}$  ions, concentration quenching was shown. The present study implies that the  $Ba_2Ca(PO_4)_4:Dy^{3+}$  phosphors would be a suitable choice for solid-state lighting applications as a near ultraviolet convertible phosphor.

#### 1. Introduction

Recent studies on the synthesis process and characteristics of trivalent rare earth ions doped phosphor materials have attracted a lot of attention due to their outstanding applications in SSL, energy storage, and other fields [1–3]. Pc-w-LEDs are popular energy saving solid state lighting technologies. When compared to traditional lighting sources, pc-w-LEDs have the advantages of being more energy efficient, smaller in size, more efficient, have a longer lifetime, have eco-friendly properties, and are easier to manufacture [4–7]. The development of a phosphor material that could be excited by n-UV and emit visible light took a lot of effort.

Phosphate is frequently used as a phosphor host due to its chemical features, easy synthesis, excellent light efficiency, and small particle size. Because of their high thermal and hydrolytic stability, phosphate oxide compounds (ABPO<sub>4</sub>:  $A = K^+$ ,  $Rb^+$ ,  $Li^+$ ,  $Cs^+$ ,  $Na^+$ ;  $B = Ca^{2+}$ ,  $Mg^{2+}$ ,  $Ba^{2+}$ ,  $Sr^{2+}$ ) are expected to be suitable luminous hosts [8]. The phosphors based on alkaline earth phosphate compounds have received significant attention for detailed investigation due to their vast applicability in illustrations and displays. Among the rare earth ions,  $Eu^{3+}$  ions provide a one-of-a-kind mix of intra-configurational  $4f \rightarrow 4f$  transitions with electric or magnetic properties, making them extremely sensitive to their surroundings.  $Eu^{3+}$  ions often emit in the orange-red area, which is attributable to emissions from the <sup>5</sup>D<sub>0</sub> level [9,10]. Because of the combination of its yellow  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$ ) and blue ( ${}^{4}F_{9/2}$ 

 $_{2} \rightarrow {}^{6}H_{15/2}$ ) emissions, Dy<sup>3+</sup> has been widely employed in a wide range of host materials for generating white light emission. [11–13]. Obtaining white light with tunable associated colour temperature (denoted as CCT) for Dy<sup>3+</sup> doped phosphor has remained a difficulty up to this point. Numerous investigations have been done on phosphate materials, including Ca<sub>5</sub>(PO<sub>4</sub>)F [14], LaPO<sub>4</sub> [15] and BiPO<sub>4</sub> [16]. The Ba<sub>2</sub>Ca (PO<sub>4</sub>)<sub>4</sub>:Dy<sup>3+</sup> phosphors were synthesized using a wet chemical technique in this study. We carefully investigated the photoluminescence characteristics and CIE coordinates. The Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>4</sub>:Dy<sup>3+</sup> phosphors were synthesized using a wet chemical technique, and the phosphors have great potential application in solid-state lighting.

#### 2. Experimental

Wet chemical techniques were used to synthesize the Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>4</sub>: Dy<sup>3+</sup> phosphor. The sample was prepared using barium nitrate, calcium nitrate, ammonium dihydrogen phosphate, and dysprosium oxide. Analytical Reagent (AR) grade materials and chemicals are utilized. The samples should be put first on the sample weighing and weight box. Dysprosium oxide is converted to dysprosium nitrate by dissolving Dy<sub>2</sub>O<sub>3</sub> into an HNO<sub>3</sub> solution. In a beaker, separate stoichiometry ratios of Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>4</sub>:Dy<sup>3+</sup> phosphor materials were dissolved in distilled water. The solutions were then combined in a single beaker to produce the required compound. The sample became transparent after 30 min of stirring, and a powder product was achieved after 12 h of heating at

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#### Study the photoluminescence properties of Ca<sub>4</sub>Al<sub>14</sub>O<sub>25</sub>:Dy<sup>3+</sup> phosphor for solid state lighting

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#### Study the Photoluminescence Properties of Ca<sub>4</sub>Al<sub>14</sub>O<sub>25</sub>:Dy<sup>3+</sup> Phosphor for Solid State Lighting

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Abstract.  $Ca_4Al_{14}O_{25}:Dy^{3+}$ phosphor was synthesized by combustion synthesis. Photoluminescence (PL) characterization employed to characterize their luminescent properties. Under ultraviolet excitation with a wavelength of 347 nm, phosphor shows blue and yellow emission, which were probably attributed to the transitions from  ${}^{4}F_{9/2}$  excited state to  ${}^{6}H_{15/2}$  and  ${}^{6}H_{13/2}$  ground states of  $Dy^{3+}$  ions. As the yellow emission is more intense and dominant over the blue emission Photoluminescence (PL) spectrum then the  $Dy^{3+}$  is located at low symmetry local site. The Photoluminescence (PL) results suggest that prepared phosphor might be applicable in solid state lighting.

#### **INTRODUCTION**

In everyday occurrence, luminescence materials have enacted an inestimable position with their most accessible application that is self-lit signalization. This phenomenon indicate the ability of a material to accumulate energy from (artificial) lighting, including visible and ultraviolet (UV) radiation, around it and to moderately release it as luminous in the murk at room temperature [1]. Alkaline earth aluminate phosphors doped with Dy<sup>3+</sup> activator ion seize protected, chemically balanced and strong photoluminescence (PL) observed in visible and near ultraviolet region, compared to the conventional sulphide-based phosphors [2-5]. Thus, a different types of calcium aluminates such as  $Ca_2Al_2O_5:RE^{3+}$  (RE = Eu,Dy,Tb)[4],CaAl\_2O\_4:Eu^{3+[6]},CaAl\_4O\_7:Bi^{3+}[7],CaAl\_2O\_4:Eu^{2+},Dy^{3+}[8] and  $Ca_3Al_2O_6$ :Sm<sup>3+</sup>,Tb<sup>3+</sup> [9] etc. are studied as host materials for solid state light applications [10]. Among various regions, (Dy3+) is one of the most suitable activator ion which exhibits intense yellow (574nm) and blue (481 nm) emissions corresponding to the  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$  and  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  transitions, respectively. Thus, the Dy<sup>3+</sup> doped materials are more suitable to produce two primary colours as well as white light emission. The  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$  (yellow) transition is a host sensitive and the  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  (blue) transition is host insensitive [11–15]. Thus, the yellow to blue (Y/B) intensity ratios can be modulated by varying the coordination environment of the host material or by changing the concentration of Dy3+ ions [16-18]. Most aluminate based phosphor are characterized by physical as well as optical means to determine their practical behaviour. In the present study, we have synthesized  $Ca_4Al_{14}O_{25}:Dy^{3+}$  using combustion process. The prepared samples were characterized by photoluminescence (PL) technique. The PL characteristics of Dy<sup>3+</sup> dopedCa<sub>4</sub>Al<sub>14</sub>O<sub>25</sub>compound was discussed in details.

#### EXPERIMENTAL

The successfully synthesis  $Ca_4Al_{14}O_{25}:Dy^{3+}$  phosphor done by simple combustion method. The raw materials in the form of nitrate, calcium nitrate (Ca (NO3)2 .6H2O: 99.99%), aluminium nitrate (Al(NO3)3. 9H2O: 99.99%) and Dysprosium oxide (Dy2O3:99.99%) are the sources of Ca, Al and Dy respectively. Urea (NH2CONH2) is used as

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#### RESEARCH ARTICLE | MAY 15 2023

#### Photoluminescence properties of Ca,AI,O,:Sm<sup>3+</sup> down conversion phosphor for eco-friendly solid state lighting applications

V. R. Panse Samirkumar R. Bhelave; A. N. Yerpude; ... et. al

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#### Photoluminescence Properties of Ca<sub>2</sub>Al<sub>2</sub>O<sub>5</sub>:Sm<sup>3+</sup> Down Conversion Phosphor for Eco- Friendly Solid State Lighting Applications

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**Abstract.** Photoluminescence (PL) and optical properties for the samarium doped calcium aluminate based  $(Ca_2Al_2O_5:Sm^{3+})$  phosphor studied and would be good potential candidate for state lighting. The conventional simple combustion method were used to synthesis the given phosphor  $Ca_2Al_2O_5:Sm^{3+}$  for 1 mole%. PL emission performance with an excitation energy of 409 nm, peaks located at 520–670 nm due to the Sm<sup>3+</sup> intraconfigurational (f-f) transition. Based on the results, prepared compound  $Ca_2Al_2O_5:Sm^{3+}$  phosphors exhibit great potential may be applicable as a LED to enhance the efficiency for solid state lighting.

#### **INTRODUCTION**

A core objective of modern material physics is the rummaging of high-efficiency, good colour rendering index (CRI), better material stability and long lasting lifetime for solid-state lighting applications [1-3]. Especially, thermodynamic activities of metastable compounds strongly depend upon atomic-scale structural robustness, temperature, life span of phosphorescenceand chemical accretive added. The number of phosphors displays an analogy of a strong energy absorption in the wavelength range of lower than 300 nm. This occurred because of the charge transfer and transition of 4f n-4f n-15d in rare earth ions [4]. In the recent past, numbers of researchers have been engrossed on the formation of lanthanide ions doped calcium aluminate phosphors. For example, calcium aluminate phosphors doped with lanthanide ions such as europium ( $Eu^{3+}$ ), dysprosium ( $Dy^{3+}$ ), gadolium ( $Gd^{3+}$ ), terbium ( $Tb^{3+}$ ), cerium ( $Ce^{3+}$ ) has been reported to enhance the luminescence characteristics of calcium aluminate phosphors. In addition with that the we studied importantly the consequence of the ion doping incorporation on the optical property of calcium based aluminate phosphor. The influence of doped ion species on the physical and chemical properties and optical activity of calcium aluminate has been rarely concerned [5-8]. A various advantages have been reported like long lasting lifetime, reasonable and environment friendly. Literature provides that appears in aluminate based phosphors prepared by different processes like conventional solid state method, combustion synthesis, wet chemical hydrothermal process etc. which depends on the temperature, properties of materials and dopant used [2,9].Because of the significance of the orange reddish light emitting phosphor in the solid state lighting, the main objective of this work is to find the capability of calcium aluminate doped samarium ions for generating a superior phosphor material which emitting orange reddish light with high proficiency as well as proper colour rendering index. Eu<sup>3+</sup>, Dy<sup>3+</sup> and Tb<sup>3+</sup> doped alkali metal ions Ca<sub>2</sub>Al<sub>2</sub>O<sub>5</sub> in demonstrating the ability of  $Eu^{3+}$ ,  $Dy^{3+}$  and  $Tb^{3+}$  in terms of its photoluminescence performance as incorporated into the host phosphor affecting

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#### Research Article

# Combustion synthesized novel SrAlBO<sub>4</sub>:Eu<sup>3+</sup> phosphor: Structural, luminescence, and Judd-Ofelt analysis



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#### ARTICLEINFO

Keywords: Phosphor XRD SEM EDAX Judd-Ofelt

#### ABSTRACT

A series of new phosphor SrAlBO<sub>4</sub> doped by Eu<sup>3+</sup> was synthesized by using very known Combustion method. The structural and optical properties explored using X-ray diffraction (XRD). The XRD pattern was matched well with the standard PDF card no. 1542236. The obtained phosphor had orthorhombic structure with space group Pccn (56). The image of Scanning electron microscope shows the external morphology of SrAlBO<sub>4</sub> phosphor material, which revails the irregular morphology and the material showed the non uniform structure with agglomerates' size was size ranging in several micrometers. The confirmation of present element and their percentage also shown in the EDX image. The luminescence properties of rare earth activated SrAlBO<sub>4</sub> phosphor were determined by measurement of excitation and emission spectra. The PL emission spectra of Eu<sup>3+</sup> doped SrAlBO<sub>4</sub> phosphor show characteristics bands at 590 nm & 614 nm which corresponds due to  ${}^{5}\text{D}_{0} \rightarrow {}^{7}\text{F}_{1}$  and  ${}^{5}\text{D}_{0} \rightarrow {}^{7}\text{F}_{2}$  transition of Eu<sup>3+</sup> ions upon 395 nm excitation. The effect of different concentration of explained using Blasse's equation and Dexter's theory. Also, Judd-Ofelt analysis was performed on photoluminescence emission spectra. On investigation synthesized rare earth activated SrAlBO<sub>4</sub> phosphor can be suitable for all lighting application devices.

#### 1. Introduction

The various issues for the increasing human population are arises, related to the environmental pollution and energy saving, providing the force for the new research on WLEDs as the next path of lighting for the purpose of energy saving. Luminescence have a wide range of applications, including in lighting, displays, medical imaging, sensors, material science and even in biomedical research and therapy [1,2]. A white light emitting diode (w-LED) is a type of LED that emits white light. Unlike traditional light bulbs, which produce white light by heating a filament to high temperatures, w-LEDs are more energy-efficient than traditional incandescent bulbs and have a longer lifespan. LEDs have many applications in the solid state lighting devices such as low cost, stability and reliability and most important high electro optical efficiency. They are widely used in a variety of applications, such as lighting for homes, offices, and outdoor spaces, as well as in electronic devices like TVs, smartphones, and laptops. Phosphor for white light emitting diode that

can be excited in near ultraviolet region around 400 nm and suitable CIE chromaticity Coordinate is essential. Generally, there are three types of techniques for which to realizes WLEDs: combination of blue LED chip with yellow phosphor or mixing of RGB LEDs (red, green, blue), excitation of multiphosphors using near ultra violet LEDs. The WLEDs are manufactured from mixture of phosphors which exhibits low efficiency and strong reabsorption. The following host materials are employed for lightning applications: silicate, borate, aluminate, phosphates, oxides, nitrides, etc [3-11]. Among that borate are good candidate of host material due to their wide application in solid state lighting and high luminescence properties [12,13]. Borate is often used in solid-state lighting applications, such as LED lighting and displays [14-17]. Borate has several advantages over other types of phosphors. They are more efficient at converting blue light to other colors, which means that they can produce brighter and more vivid colors. They also have good thermal stability, which means that they can maintain their brightness even at high temperatures. Lanthanides doped borate phosphors can be

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# Synthesis and photoluminescence study of KCaPO<sub>4</sub>:Eu<sup>3+</sup> phosphors for solid state lighting



terials letters:

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#### ARTICLE INFO

Keywords: Phosphate Photoluminescence Solid state lighting CIE chromaticity coordinates Phosphor

#### ABSTRACT

A series of KCaPO<sub>4</sub>: $Eu^{3+}$  phosphors was effectively synthesized utilizing a wet chemical method. The photoluminescence excitation and emission properties of the phosphor were investigated. The KCaPO<sub>4</sub>: $Eu^{3+}$  phosphor was efficiently excited at 394 nm, and the PL (Photoluminescence) emission spectra were obtained at 591 and 614 nm. Concentration quenching occurred at a  $Eu^{3+}$  ion concentration of 0.5 mol%. The present work suggests that the KCaPO<sub>4</sub>: $Eu^{3+}$  phosphors may be a potential candidate as a near-UV (Ultraviolet) convertible material for solid state lighting applications.

#### 1. Introduction

Due to advantageous great brightness, consumption of low power, and extended operating life, w-LEDs have been regarded as significant solid state light sources. Lanthanide ions phosphors have long attracted the attention of researchers because of their vital applications in a variety of fields like solid state lasers, biomolecule detection, sensing devices, diagnostic imaging, plasma displays, and w-LEDs [1-4]. Due to the presence of exceptional properties, such as strong light efficiency, eco-friendliness, absence of hazardous mercury, long life, compact nature, and durability, pc-w-LEDs had lately been recognized as the most promising technological developments in the current generation of the SSL industry [5.6]. They are utilized in a variety of applications, including indicators, automotive headlights, backlights, and general illumination [7.8]. The most popular technique for creating w-LEDs was developed by S. Nakamura et al. in 1997 [9], combining both the bluebased InGaN LED (Light Emitting Diode) chip and the yellow-emitting (yttrium aluminum garnet) YAG:Ce3+ phosphors. A poor colour executing index (CRI, Ra 7000 K) brought due to the absence of a red component and significant thermal quenching are two shortcomings of the pc-w-LEDs previously discussed [10-12].

As a result, the creation of novel, highly efficient phosphors triggered by near-UV chips has received a lot of attention in the process of making w-LEDs [13]. Due to transitions  ${}^{5}D_{0} \rightarrow {}^{7}F_{J}$  (J=0, 1, 2, 3, 4), the trivalent europium ion has been identified as one of the best activators in the

phosphors. Due to their outstanding luminescence, cheap cost, and high efficiency, orthophosphate phosphate  $Eu^{3+}$  doped with rare earth elements like  $Sr_3La(PO_4)_3$ : $Eu^{3+}$  [14], BiPO4: $Eu^{3+}$  [15] and  $Ba_3(PO_4)_2$ : RE (RE =  $Sm^{3+}$ ,  $Eu^{3+}$ ,  $Dy^{3+}$ ) [16], are employed to generate these phosphors prepared by wet chemical synthesis. In this study, the KCaPO\_4:  $Eu^{3+}$  phosphors were prepared utilizing a wet chemical technique. We carefully investigated the photoluminescence properties and CIE coordinates. The KCaPO\_4: $Eu^{3+}$  phosphors were produced by a wet chemical technique and the phosphors have great potential in solid-state lighting.

#### 2. Experimental

The wet chemical method was used to synthesize the KCaPO<sub>4</sub>:xEu<sup>3+</sup> (where x = 0.1, 0.3, 0.5, 1 mol%) phosphor. The sample was prepared using potassium nitrate, calcium nitrate, ammonium dihydrogen phosphate, and europium oxide. Analytical Reagent grade materials and chemicals are utilized. The samples should be put first on the sample weighing and weight box. Eu<sub>2</sub>O<sub>3</sub> is dissolved into an HNO<sub>3</sub> solution to change europium oxide into europium nitrate. Potassium nitrate, calcium nitrate, and ammonium dihydrogen phosphate were all independently dissolved in separate beakers with double distilled water. A single beaker containing the mixed dissolved solutions was placed on the magnetic stirrer. The sample became transparent after 30 min of stirring, and a powder product was achieved after 14 h of heating at 80 °C in a

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# Synthesis and luminescence properties of Dy<sup>3+</sup> ions doped KMgPO<sub>4</sub> phosphor for eco-friendly solid-state lighting

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Abstract.  $Dy^{3+}$  ions doped KMgPO<sub>4</sub> phosphor was synthesized using a simple wet chemical method and reported the photoluminescence (PL) properties. The prepared XRD pattern matches well with the standard JCPDS file. Under 350 nm excitation, the KMgPO<sub>4</sub>:Dy<sup>3+</sup> phosphor exhibits two emission peaks at wavelengths 470 and 577 nm, corresponding to the characteristic energy transitions  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  and  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$ , respectively. The PL intensity was found maximum at a Dy<sup>3+</sup> ions concentration of 0.5 mol%. The findings are considered to be potential candidates for KMgPO<sub>4</sub>:Dy<sup>3+</sup> phosphor for eco-friendly solid-state illumination.

Keywords. Wet chemical method; XRD; photoluminescence; phosphate phosphor; SSL.

#### 1. Introduction

Among the different solid-state lighting (SSL) technologies, phosphor-converted white light-emitting diodes (pcw-LEDs) are currently replacing traditional light sources, such as incandescent and fluorescent bulbs due to their energy efficiency and ease of maintenance. Phosphorconverted white light-emitting diodes (pc-w-LEDs) have evolved over the years to remain as the dominant leader in the lighting industry. The w-LEDs have perceived a lot of interest in recent decades due to their long life, small size, high efficiency, energy savings, eco-friendliness and other benefits [1, 2]. The orthophosphate is discovered to be a prominent host owing to its low sintering temperature, high physical chemistry stability and thermal stability. As a result, orthophosphate is a good host for photoluminescence (PL) compounds [3, 4]. The proposed research work will be focused on the preparation of Dy<sup>3+</sup> rare-earth-doped orthophosphate phosphors. In particular, rare-earth phosphates have proved to be very useful host lattices for luminescence. Orthophosphate  $PO_4^{-3}$  has a tetrahedral structure of the phosphate family, with a phosphorus atom in the centre surrounded by four oxygen atoms. Commercial w-LEDs may now be made using a blue LED chip and the Y<sub>3</sub>Al<sub>5</sub>O<sub>12</sub>:Ce<sup>3+</sup> yellow colour emitting phosphor. Some primary drawbacks of these YAG-based w-LEDs are due to their low CRI ( $R_a < 75$ ) and CCT (> 6000 K), which are due to the lack of a redemitting component [5].

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Researchers worked hard to create an efficient and stable phosphor material that could be activated by n-UV and emitted in the visible range. So, after reviewing the literature on phosphates, we are drawn to the phosphate family of materials because of their simple synthesis technique [6], strong thermal stability [7], large bandgap [8] and chemical stability [9]. Rare-earth ions have played a significant role in the creation of many commercial phosphors and are currently being investigated for improving the optical properties of materials [10].

With respect to the other rare-earth dopants,  $Dy^{3+}$  ions are widely used as activators in different inorganic materials like borate and phosphate to produce novel phosphors for w-LEDs [11, 12]. The synthesized phosphor is constituted of two primary emission peaks of  $Dy^{3+}$  ions: first at 470 nm from the transition  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  and the second at 577 nm from the transition  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$  [13]. Several rare-earth ion-doped phosphor component possible candidates for use in n-UV excited SSL has previously been reported:  $Ca_{3}B_{2}O_{6}:Dy^{3+}, Eu^{3+}$  [14], MgCaAl<sub>10</sub>O<sub>17</sub>:Dy<sup>3+</sup>, Sm<sup>3+</sup> [15] and  $Ca_2Al_2O_5:Dy^{3+}$ ,  $Eu^{3+}$  and  $Tb^{3+}$  [16]. Nandanwar *et al* [17] reported wet chemical synthesis technique of Ba3(PO4)2:RE =  $Dy^{3+}$ ,  $Sm^{3+}$  and  $Eu^{3+}$  phosphor. As a result of its importance in traditional SSL, the PL performance of rareearth ions doped phosphate phosphors has been thoroughly studied. Ramteke et al [18] investigated the PL performance of KMgPO<sub>4</sub>:Eu<sup>3+</sup> phosphor phosphate samples for n-UV based solid-state illumination. This study shows that powder samples of  $KMgPO_4:Dy^{3+}$  phosphors were first time

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#### Combustion synthesis of KZnPO<sub>4</sub>: RE (RE = $Dy^{3+}$ and $Sm^{3+}$ ) Phosphors for n-UV based w-LEDs

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Abstract. In this work,  $KZnPO_4:Dy^{3+}$  and  $KZnPO_4:Sm^{3+}$  phosphors are synthesized using the Combustion technique. The phosphor XRD and photoluminescence properties were studied. The XRD was used to confirm the orthorhombic phase with the space group P n a 21. The PL emission spectra of the synthesized  $KZnPO_4:Dy^{3+}$  phosphor shows a strong emission at 482 and 574 nm under 350 nm excitation, which is ascribed due to  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  and  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$  electronic transitions of the  $Dy^{3+}$  ions, respectively. When the  $KZnPO_4:Sm^{3+}$  phosphor was excited at 402 nm, the emission spectra exhibited prominent bands located at 562 and 597 nm. The CIE coordinates show that the current phosphors have high colour purity. The  $KZnPO_4:Dy^{3+}$  and  $Sm^{3+}$  phosphors provide an excellent candidate for n-UV-based w-LEDs.

#### 1 Introduction

Recently, white-light emitting diodes (w-LEDs) as the fourth-generation solid state lighting (SSL) source have gotten a lot of interest in solid-state illumination lighting [1-4]. White-light emitting diodes (w-LEDs) offer several benefits over traditional illuminants, including extended life, eco-friendly, efficiency, and energy savings [5,6]. In the commercial lighting sector, hybrid multi-light colour phosphors have currently attained mainstream warm white illumination. A hybrid multi-light phosphor source's colour rendering index is poor due to the reabsorption of the multiple phosphors, and its red emission is not appropriate [7]. The luminous performance of phosphors may be significantly improved by doping them with appropriate auxiliary activators. Most of lanthanides are doped as  $\text{Sm}^{3+}$  ions and have specific optical properties. In general, a phosphor with multi-colour emission peaks is created by doping lanthanide ions in a host matrix.  $Dy^{3+}$ ions, one of the lanthanide ions, is one of the possible luminous centers owing to their emission peaks in the yellow and blue areas. The  $\text{Sm}^{3+}$  ions are active ions for numerous inorganic host matrix and mostly function as a prominent emission center because of their energy level structure and strong luminescence efficiency [8].

Researchers investigated orthophosphates such as  $KSrPO_4$  [9],  $BiPO_4$  [10],  $NaBaPO_4$  [11], and  $LiBaPO_4$  [12], which had good optical characteristics and were proposed as novel phosphors materials for use in w-LEDs. The characteristics of  $KZnPO_4$  phosphors with rare earth ions have been studied. Due to the combined synthesis of its yellow and blue emissions,  $Dy^{3+}$  ions have been extensively

employed in a range of host materials for direct w-LEDs. Duan [13] reported the KZnPO<sub>4</sub>:Dy<sup>3+</sup>, Sm<sup>3+</sup> phosphor prepared by solid state reaction method. The combustion method is one of the most well-known ways of producing a variety of phosphors because of its simplicity, wide applicability, and ease of production with required composition. The solid-state method, which is simple to use and has advantages including high yield, environmental friendliness, homogenous distribution of particle sizes, and controllable size, can meet these needs. Tamrakar et al. reported the comparison of photoluminescence properties of Gd<sub>2</sub>O<sub>3</sub> phosphor prepared by solid state method and combustion method and found that the overall shape of the emission spectra does not change [14]. Also according to Tamrakar et al., the emission intensity of the phosphor synthesized using the solid state method is higher than that of the phosphor synthesized using the combustion method [14]. According to Dwivedi et al., the green emission intensity of YVO<sub>4</sub>:Ho<sup>3+</sup>,Yb<sup>3+</sup> phosphor prepared by the solid-state method is higher than that of phosphor prepared by combustion method [15]. In this work, we have prepared the KZnPO<sub>4</sub>:Dy<sup>3+</sup> and KZnPO<sub>4</sub>:Sm<sup>3+</sup> phosphors by combustion synthesis. The luminescence property of  $KZnPO_4:Dy^{3+}$  and  $KZnPO_4:Sm^{3+}$  phosphors is thoroughly investigated in this work. The resulting materials were examined using XRD and the photoluminescence properties of KZnPO4:Dy3+ and KZnPO4:Sm3+ phosphors were studied.

#### 2 Experimental

A series  $KZnPO_4:xDy^{3+}$  (x=0.1, 0.3, 0.5 and 1 mol%) and  $KZnPO_4:xSm^{3+}$  (x=0.3, 0.5, 1 and 1.5 mol%) phosphors were synthesized using a combustion technique. The fuel

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## Effect of charge compensators $A^+$ ( $A^+$ = Li, Na and K) on photoluminescence properties of $Ba_2Ca(PO_4)_2$ :Eu<sup>3+</sup> phosphor for solid state lighting

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#### ABSTRACT

The Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>2</sub>:Eu<sup>3+</sup> phosphors that were co-doped in the alkali metal ions A<sup>+</sup> (A<sup>+</sup> = Li, Na and K) to improve their luminescence property were synthesized by wet chemical method. X-ray diffraction confirmed the phase formation. When excited at 394 nm wavelength, the Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>2</sub>:Eu<sup>3+</sup> phosphor showed an emission peak at 591 and 615 nm. The intensity of the Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>2</sub>:Eu<sup>3+</sup> phosphor emission could reach a maximum of 0.5 mol % and then concentration quenching occurs. The emission intensity can be increased by introducing compensator charge A<sup>+</sup> (A<sup>+</sup> = Li, Na and K) into the Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>2</sub>:Eu<sup>3+</sup> phosphor. In contrast, all three charge compensators may improve luminescence emission intensity, among these charge compensating ions Li<sup>+</sup> being the most effective. The chromaticity coordinates of the Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>2</sub>:Eu<sup>3+</sup>, Li<sup>+</sup> phosphor were (*x* = 0.680, *y* = 0.319) according to the CIE. The findings indicate that Ba<sub>2</sub>Ca(PO<sub>4</sub>)<sub>2</sub>:Eu<sup>3+</sup>, A<sup>+</sup> (A<sup>+</sup> = Li, Na and K) phosphors with excellent photoluminescence properties will be used as a component in near-ultraviolet exciting solid state lighting.

#### 1 Introduction

Phosphate materials have received a lot of attention as a possible host for ions from rare earth. These materials are a new development of SSL (solid state lighting) devices that are emerging as a significant non-contaminated. Various lanthanide-doped phosphate compounds have a wide range of applications, including solid-state lasers, display systems, w-LEDs and environmental friendliness [1–4]. Phosphor-converted w-LEDs are widely used in displays [5]. Rare earth ion activated phosphor materials have received extensive study due to their brilliant structural, chemical and thermal properties, as well as their varied range of applications. The 4f–4f based on intra electronic transitions in rare earth ions result in relatively long-lived narrow band emissions [6, 7].

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#### Wet chemical synthesis of Sm<sup>3+</sup> doped Ca<sub>10</sub>(PO<sub>4</sub>)<sub>6</sub>Cl<sub>2</sub> phosphor for w-LED application

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ARTICLE INFO	ABSTRACT
Keywords: Photoluminescence Wet chemical method w-LEDs CIE chromaticity coordinates	Wet chemical technique was used for the Synthesis of $\text{Sm}^{3+}$ doped $\text{Ca}_{10}(\text{PO}_4)_6\text{Cl}_2$ phosphor. The phase purity was analyzed by using X-Ray diffraction (XRD), which show that the synthesized phosphor was well matched with standard PDF file. Photoluminescence properties of $\text{Ca}_{10}(\text{PO}_4)_6\text{Cl}_2:\text{Sm}^{3+}$ phosphor shows emission peak at 563 nm, 607 nm & 646 nm corresponding to ${}^4\text{G}_{5/2} \rightarrow ({}^6\text{H}_{5/2}, {}^6\text{H}_{7/2}, {}^6\text{H}_{9/2})$ transition of $\text{Sm}^{3+}$ ions. The emission spectra of $\text{Ca}_{10}(\text{PO}_4)_6\text{Cl}_2:\text{Sm}^{3+}$ phosphor was very intense and sharp. As per the current investigation of syn- thesized phosphor, it indicate that it is a used in solid state lighting devices and display application

#### 1. Introduction

The Optical material have more attention of researcher and Scientific community for developing materials for white lighting emitting diode (w-LED) [1-4]. The next generation of solid state lighting devices, known as w-LEDs, are on the approach of replacing conventional lighting sources like fluorescent lamps due to their benefits in terms of energy efficiency and environmental friendliness [5,6]. Due to its low production costs, excellent brightness, long life, quick reaction, and lack of pollution, lanthanides activated phosphor has a wide range of applications. Numerous photoluminescent materials, including silicate, borate, aluminate, oxides, and nitrides, have all been used in lightemitting diodes. Because of their simple production, low synthesis temperature, and high luminescence brightness, phosphates make suitable hosts. The phosphate phosphor has great thermal and chemical stability, a wide band gap, and strong absorption [7-9]. The oxide based of host materials having large range of application in super capacitor, superconductors, radio frequency, electronic component, microwave and solid state lighting [10-11]. According to literature survey, the deposition precipitation process is used to produce blue-emitting  $Ca_{10}(PO_4)_6Cl_2:Eu^{2+}$  phosphor [12].  $Eu^{3+}$  substituted  $Ca_{10}(PO_4)_6Cl_2$ phosphor were synthesized by microwave assisted hydrothermal method and their structural and optical properties studied systematically [13]. Samarium ions (Sm<sup>3+</sup>) are integrated into a phosphate host lattice in samarium-doped phosphate phosphors, a particular class of luminous material. The activator Sm3+ ions are widely use for the

reddish (646 nm) or orange (607 nm) emission due to its transition of  ${}^{4}G_{5/2}^{0} \rightarrow H_{J}$  (J = 5/2,7/2 & 11/2). Samarium-doped phosphate phosphors are suited for a variety of applications due to their unique characteristics [14–17]. As per the investigation the  $\text{Sm}^{3+}$  doped  $\text{Ca}_{10}(\text{PO}_4)_6\text{Cl}_2$  phosphor was 1st time synthesized by wet chemical method. The prepared sample were characterized by XRD and photoluminescence properties.

#### 2. Experimental

In this work, Ca10(PO4)6 Cl2:Sm3+ phosphor with various concentration of Sm<sup>3+</sup> ions varying from 0.5%, 1%, 1,5%, 2% & 2.5 % mole % phosphor were successfully synthesized by wet chemical method. The stoichiometric amount of calcium nitrate, Ammonium dihydrogen phosphate, Ammonium chloride and samarium oxide are weighted accurately by using digital monopan balance. All the materials are in AR grade. Firstly Samarium oxide converted, form oxide to nitrate form using nitric acid. Rare earth Sm<sub>2</sub>O<sub>3</sub> material are dissolved in dilute nitric acid solution. Then put into the furnace at low temperature till all solution are evaporate and dry Compound are formed. All the weighing materials were transferred into a small glass beaker and dissolved separately in 20 ml of distilled water and stirrer for about 30 min. Then all the solution are mixed in one beaker and stirred using magnetic stirrer for 30 min. The stirred solution are placed in hot plate in magnetic stirrer for 6 to 8 h at 80 °C. After that the white powder product was formed. The obtained powder was crushed by mortal and pestle to form a fine powder then the powder were placed in crucible and

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#### **RESEARCH ARTICLE**

#### LUMINESCENCE The Journal of Biological and Chemical Luminescence WILEY

# Structural, morphological, and photoluminescence properties of RE (RE = $Dy^{3+}$ , $Eu^{3+}$ , $Sm^{3+}$ )-doped CaAlBO<sub>4</sub> phosphor synthesized by combustion method

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#### Abstract

The CaAlBO<sub>4</sub>:RE (RE =  $Dy^{3+}$ ,  $Eu^{3+}$ ,  $Sm^{3+}$ ) phosphor were prepared via combustion synthesis and studied by X-ray diffraction (XRD), Fourier-transform infrared (FTIR) analysis, scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), photoluminescence (PL) spectra and CIE coordinates. The phase formation of the obtained phosphor was analyzed by XRD and the result was confirmed by standard PDF Card No. 1539083. XRD data successfully indicated pure phase of CaAlBO<sub>4</sub> phosphor. The crystal structure of CaAlBO<sub>4</sub> phosphor is orthorhombic with space group Ccc2 (37). The SEM image of CaAlBO<sub>4</sub> phosphor reveals an agglomerated morphology and non-uniform particle size. The EDS image provides evidence of the elements present and the chemical makeup of the materials. Under the 350 nm excitation, the emission spectrum of Dy<sup>3+</sup> activated CaAlBO<sub>4</sub> phosphor consists of two main groups of characteristic peaks located at 484 and 577 nm which are ascribed to  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  and  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$  transition of Dy<sup>3+</sup> respectively. The PL emission spectra of CaAlBO<sub>4</sub>:Eu<sup>3+</sup> phosphor shows characteristics bands observed around 591 and 613 nm, which corresponds to  ${}^{5}D_{0} \rightarrow {}^{7}F_{1}$  and  ${}^{5}D_{0} \rightarrow {}^{7}F_{2}$ transition of Eu<sup>3+</sup> respectively, upon 395 nm excitation wavelength. The emission spectra of Sm<sup>3+</sup> activated CaAlBO<sub>4</sub> phosphor shows three characteristic bands observed at 565, 601 and 648 nm which emits yellow, orange and red color. The prominent emission peak at the wavelength 601 nm, which is attributed to  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{7/2}$  transition, displays an orange emission. The CIE color coordinates of CaAlBO<sub>4</sub>:RE (RE =  $Dy^{3+}$ ,  $Eu^{3+}$ ,  $Sm^{3+}$ ) phosphor are calculated to be (0.631, 0.368), (0.674, 0.325) and (0.073, 0.185). As per the obtained results, CaAlBO4:RE  $(RE = Dy^{3+}, Eu^{3+}, Sm^{3+})$  phosphor may be applicable in eco-friendly lightning technology.

#### KEYWORDS

borate, combustion synthesis, phosphor, photoluminescence, SEM, X-ray diffraction

#### 1 | INTRODUCTION

In the past decades, research and the scientific community have been more interested in the development of lanthanide-activated phosphor because of its large applications in areas such as plasma display, solar cells, laser, white light, bio-imaging and phototherapy [1–4]. In the current investigation, there are a number of research papers on the development of inorganic phosphors and on trying to improve the

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#### Samirkumar R. Bhelave<sup>1</sup>, A. N. Yerpude<sup>2</sup>, S. J. Dhoble<sup>3</sup> Photoluminescence study of Sr<sub>3</sub>Al<sub>32</sub>O<sub>51</sub>:Eu<sup>3+</sup> phosphor for Solid state lighting applications

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 $Sr_3Al_{32}O_{51}$ :Eu<sup>3+</sup> phosphor prepared successfully by simple combustion method. Prepared matrix synthesized for different percentages of composition for rare earth  $Eu^{3+} = (0.5, 1.0, 1.5, 2.0, and 2.5)$ . Photoluminescence property was taken for the given doped phosphor which shows the excitation peak at 395 nm and 466 nm respectively. Emission peaks were observed at 593 nm and 613 nm for excitation wavelength 395 nm and the same emission peak observed for excitation wavelength 466 nm was comparatively less intense than 395 nm. The phase of the synthesized phosphor confirmed by X-ray diffraction spectroscopy (XRD), Scanning electron microscopy (SEM), and Photoluminescence (Pl) property shows that the given matrix is one of the potential materials that can be used for solid-state lightening.

Keywords: lanthanide; strontium aluminate phosphors; Simple combustion method; solid state lightening.

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#### Introduction

In recent days, strontium-based aluminate phosphor has attracted attraction due to its luminesce properties such as high quantum efficiency, long persistence of phosphorescence, and good stability [1-3]. In recent days inorganic light-emitting diodes (LEDs) have been widely used for different purposes due to their advantage over conventional sources [4-8]. The various rare earth (RE) elements are used for the luminescence properties in lasers, biosensors, fiber amplifiers, displays, optical thermometry, anti-counterfeiting applications, etc.[9-14]. According to the requirement of the color of emission, among them, the Eu3+ ion has been widely used in doping of host materials significantly for red photoluminescence due to the down-conversion process. Down conversion is an optical process in which a high-energy photon is converted into a low-energy photon [15]. According to energy level, the respective peak observed by Eu<sup>3+</sup> ion due to the Charge transfer band  $O^2 - Eu^{3+}$ ,  ${}^5D_{15/2} \rightarrow {}^5L_6$ ,  ${}^{5}D_{15/2} \rightarrow {}^{5}D_{2}$  respectively [16]. There are various strontium aluminate-based phosphors reported earlier such as

 $Sr_3La(AIO)_3(BO_3)_4$ [17],  $SrAl_{12}O_{19}$ [18],  $SrAl_4O_7$ [19], and  $Sr_4Al_{14}O_{25}$ [20]. In this research work the novel phosphor matrix  $Sr_3Al_{32}O_{51}$ : $Eu^{3+}$  was synthesized and studied its photoluminescence property.

The material is subjected to structural characterizations such as X-ray diffraction (XRD), and the morphology of the given sample is determined by Scanning electron microscopy (SEM). The luminescent properties are evaluated using photoluminescence (PL) measurements in detail. The excitation spectrum shows peak positions at 257 nm, 395 nm, and 465 nm respectively for the given phosphor and emission spectra 593nm and 613 nm respectively. The CIE diagram plotted by the color calculator of the given phosphor sample shows coordinates shifted in the red region. The given phosphor is used for red LEDs, display devices, photonic devices, and solid state lighting LEDs.

#### I. Experimental

The given phosphor  $Sr_3Al_{32}O_{51}$ :Eu<sup>3+</sup> is prepared by simple combustion technique for various concentrations



# Photoluminescence investigation of novel KCaPO<sub>4</sub>:Sm<sup>3+</sup> phosphors for n-UV based solid state lighting Prepared by wet chemical synthesis

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#### Abstract

The wet chemical method was used for the first time to synthesize novel KCaPO<sub>4</sub>:Sm<sup>3+</sup> phosphor. The characteristics of XRD, morphology and photoluminescence were thoroughly investigated. The hexagonal structure of KCaPO<sub>4</sub> is confirmed by the XRD analysis. The KCaPO<sub>4</sub>:Sm<sup>3+</sup> phosphor emission are peaks located at 565 nm, 599 nm and 646 nm under excited at 403 nm. Concentration quenching was shown to occur at 1 mol% of Sm<sup>3+</sup> ions. It was found that concentration quenching occurred as a result of quadrupole–quadrupole interaction according to Dexter's theory. The CIE Chromaticity coordinate of the prepared phosphor was located in the orange region around (0.602, 0.395) with high color purity. The current study suggests that KCaPO<sub>4</sub>:Sm<sup>3+</sup> phosphors could potentially represent a promising n-UV converter material for solid-state lighting applications.

**Keywords** Photoluminescence  $\cdot$  XRD  $\cdot$  Wet chemical method  $\cdot$  Phosphor  $\cdot$  Solid state lighting

#### **1** Introduction

The optical material has more attention from researchers and the scientific community for developing materials for w-LED (Yam and Hassan 2005; Yerpude et al. 2019a; Nandanwar et al. 2022; Ramteke et al. 2021). The w-LEDs are considered the next generation of solid

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#### RESEARCH



# Combustion synthesis of $Sr_2Al_2B_2O_8$ :RE (RE = Dy<sup>3+</sup>, Eu<sup>3+</sup>, Sm<sup>3+</sup>) phosphor for solid-state lightning application

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Abstract The  $Dy^{3+}$ ,  $Eu^{3+}$ , and  $Sm^{3+}$ -activated  $Sr_2Al_2B_2O_8$ phosphor is prepared by a traditional combustion method, adding urea as a fuel. The photoluminescence properties and color chromaticity coordinate of synthesized Sr<sub>2</sub>Al<sub>2</sub>B<sub>2</sub>O<sub>8</sub>: RE (RE =  $Dy^{3+}$ ,  $Eu^{3+}$ ,  $Sm^{3+}$ ) phosphors are studied. The photoluminescence emission spectra of prepared Sr<sub>2</sub>Al<sub>2</sub>B<sub>2</sub>O<sub>8</sub>: Dy<sup>3+</sup> phosphor reveal a strong emission peak lines centered at 484 nm and 577 nm in the blue and yellow regions, attributed to  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{J}$  (J = 15/2 and 13/2) of Dy<sup>3+</sup> ions transition. The strongest emission peak is located at 484 nm under the excitation wavelength at 349 nm. The Sr<sub>2</sub>Al<sub>2</sub>B<sub>2</sub>O<sub>8</sub>:Eu<sup>3+</sup> phosphor material exhibits the characteristic emission peaks located at 594 nm and 615 nm under the excitation wavelength at 393 nm, which corresponds to the transition of Eu<sup>3+</sup> ions  ${}^{5}D_{0} \rightarrow {}^{7}F_{1}$  and  ${}^{7}F_{2}$ . The PL emission spectra of Sm<sup>3+</sup>-activated Sr<sub>2</sub>Al<sub>2</sub>B<sub>2</sub>O<sub>8</sub> phosphor material consist of three strong peaks centered at 566 nm, 602 nm, and 648 nm under 404 nm excitation wavelength, which corresponds to transition  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{J}$  (J = 5/2, 7/2, and 9/2) at ground levels of Sm<sup>3+</sup> ions with the emission of yellow, orange, and red colors. The maximum doping concentration of  $Sr_2Al_2B_2O_8$ :  $Dy^{3+}$ ,  $Sr_2Al_2B_2O_8$ :  $Eu^{3+}$ , and  $Sr_2Al_2B_2O_8$ : Sm<sup>3+</sup> phosphors is found to be 0.7 mol%. The prepared phosphor material shows blue, yellow, orange,

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and red color emission with color coordinate and high color purity. These results indicate that the  $Dy^{3+}$ ,  $Eu^{3+}$ , and  $Sm^{3+}$ -activated  $Sr_2Al_2B_2O_8$  phosphor is a promising candidate of blue-yellow and orange-red-emitting materials for solid-state lightning devices, mainly WLED's.

Keywords  $Sr_2Al_2B_2O_8 \cdot Photoluminescence \cdot Solid-state lightning \cdot Combustion synthesis$ 

#### Introduction

In recent years, there has been significant interest in luminescent materials activated with rare earth (RE) ions for multiple applications. These applications include medical diagnosis, solid-state lighting, plant growth, and fiber amplifiers. The unique properties of RE ions make them attractive for these fields [1-3]. Borate phosphors possess efficient luminescence, meaning they can convert absorbed energy into light with high quantum efficiency. This property makes them useful in various lighting and display technologies. Borate phosphors are luminescent materials with tunable emission properties, finding applications in LED lighting, fluorescent lamps, scintillation detectors and biomedical imaging [4, 5]. Due to their efficient luminescence and chemical stability, borate phosphor continues to be a promising material for various optical and display technologies [6]. Recently, there has been growing emphasis on environmental protection and energy conservation. As a result, there has been a significant increase in the popularity of phosphorconverted diodes (pc-WLEDs) as a third-generation lighting resource. These LEDs, which are based on UV/blue LEDs, are regarded as a great replacement for incandescent and fluorescent illumination. They offer numerous advantages, including reduced environmental impact, high color

#### RESEARCH ARTICLE



#### Wet chemical synthesis and photoluminescence properties of NaSrPO<sub>4</sub>:Dy<sup>3+</sup> and NaSrPO<sub>4</sub>:Eu<sup>3+</sup> phosphors for near UV-based w-LEDs

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**Abstract** The NaSrPO<sub>4</sub>:Dy<sup>3+</sup> and NaSrPO<sub>4</sub>:Eu<sup>3+</sup> phosphors were synthesized with success via wet chemical synthesis. XRD and photoluminescence properties of the prepared phosphors were thoroughly investigated. The XRD was used to confirm the hexagonal phase with P6<sub>3</sub>/mmc (194) space group. The emission peaks of NaSrPO<sub>4</sub>:Dy<sup>3+</sup> phosphor are observed at 484 and 574 nm under excitation at 350 nm. When NaSrPO<sub>4</sub>:Eu<sup>3+</sup> phosphor was stimulated at 394 nm, the emission bands at 591 and 613 nm are found. The CIE coordinates indicate that the present phosphors have high colour purity. The results indicate that NaSrPO<sub>4</sub>:Dy<sup>3+</sup> and NaSrPO<sub>4</sub>:Eu<sup>3+</sup> phosphors were blue-yellow and orange-red emitting under n-UV converting w-LEDs.

**Keyword** Wet chemical synthesis · XRD · Phosphor · Photoluminescence · w-LED

#### Introduction

It is widely acknowledged that the invention of w-LEDs in this century has resulted in a significant revolution in illumination techniques due to their excellent properties such as luminous quality, energy saving, excellent stability,

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high efficiency and environmental friendliness [1–4]. Blue, green and red phosphors have been studied for application in w-LEDs [5–8]. Phosphors are an important material in lighting technology and have received a lot of attention in phosphor converted w-LEDs [9, 10]. As a result, it is important to discover new white phosphors with enhanced brightness, which originate from a single phosphor.

The most popular technique for creating w-LEDs was developed by S. Nakamura et al. in 1997 [11], combining both the blue-based InGaN LED (light-emitting diode) chip and the yellow-emitting (yttrium aluminium garnet) YAG:Ce<sup>3+</sup> phosphors. A poor colour executing index (CRI, Ra 7000 K) brought due to the absence of a red component and significant thermal quenching are two shortcomings of the pc-w-LEDs previously discussed [12, 13]. Extraordinary rare earth-doped inorganic phosphors are entrancing and have been generally investigated through ongoing numerous years. In this particular circumstance, the uncommon superior properties of trivalent ions doped phosphate materials of the type ABPO<sub>4</sub>, where A and B are monovalent and divalent cations, independently, have drawn a lot of interest [14]. To determine these issues, single-part white lightcommunicating phosphors have procured pervasiveness due to their high brilliance efficiency, assortment reproducibility and modest collecting costs [15, 16].

The Dy<sup>3+</sup> ion has two primary emission groups: blue (470-500 nm) because of the magnetic dipole  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{15/2}$  transition and yellow (570-600 nm) connected with the touchy electric dipole  ${}^{4}F_{9/2} \rightarrow {}^{6}H_{13/2}$  transition [17, 18]. Orthophosphate is regarded as an important host for luminescent materials due to its excellent properties, which include a large band gap and high absorption of PO<sub>4</sub><sup>3-</sup> in the n-UV region, moderate phonon energy, high chemical stability, exceptional optical damage threshold and low sintering temperature. Numerous investigations have been

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# Combustion synthesis and photoluminescence study of novel $\text{Sm}^{3+}$ activated K<sub>3</sub>La(PO<sub>4</sub>)<sub>2</sub> phosphor for n-UV solid state lighting

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#### ARTICLE INFO

Keywords: XRD SEM Photoluminescence Combustion synthesis Solid state lighting

#### ABSTRACT

In the present study, a novel  $K_3La(PO_4)_2:Sm^{3+}$  phosphor was prepared by the combustion method. The synthesized  $K_3La(PO_4)_2:Sm^{3+}$  phosphor was characterized by XRD, SEM, PL (emission and excitation) and color chromaticity. The recorded X-ray diffraction pattern for the phosphor matches JCPDS no. 00–047–0468. From the SEM analysis, the phosphor had an average particle size of 2–25 micrometers and had a solid microcrystalline structure with specific uneven shapes and aggregation between the crystalline grains. The maximum excitation peak occurs at 403 nm, which corresponds to the  ${}^{6}H_{5/2} \rightarrow {}^{4}F_{7/2}$  transition of the Sm<sup>3+</sup> ions. From all the observed transitions, the emission band at 598 nm ( ${}^{6}G_{5/2} \rightarrow {}^{6}H_{7/2}$ ) shows an orange-red emission with prominent intensity. The emission intensity of the  $K_3La(PO_4)_2:Sm^{3+}$  phosphor could reach a maximum of 1 mol % and then concentration quenching occurs. Further, concentration quenching is explained using Blasse's equation and Dexter's theory. The chromaticity findings of the synthesized phosphor had a CIE coordinate of (0.617, 0.381) and hence might be used for an orange-red emission in solid state lighting.

#### 1. Introduction

Orthophosphate phosphors are a type of phosphor material that is commonly used in fluorescent lighting and display technologies. Orthophosphate phosphors have a high conversion efficiency, which means they can convert a large portion of the input energy into light [1–5]. They produce a high level of brightness compared to other types of phosphors, making them ideal for use in applications where bright light is required. Orthophosphate phosphors produce a relatively broad spectrum of light, which makes them capable of rendering colors accurately [6–9]. They have a relatively long lifespan, which means they can last for a long time without needing replacement. Orthophosphate phosphors are highly stable and resistant to degradation, which makes them suitable for use in harsh environments. They are non-toxic and environmentally friendly, which makes them safe to use in a variety of applications [10–12].

When  $\text{Sm}^{3+}$  ions are incorporated into the orthophosphate lattice, they interact with the surrounding ions and lattice structure in several ways. The crystal field can split the energy levels of the  $\text{Sm}^{3+}$  ions into different states, which can affect the emission and absorption spectra of the material [13–15]. When  $\text{Sm}^{3+}$  ions are incorporated into an orthophosphate lattice, they may create charge imbalances that need to be compensated for by other ions in the lattice. This can lead to the formation of defects or the incorporation of other ions into the lattice [16,17]. The size of the  $Sm^{3+}$  ions can affect the crystal structure of the orthophosphate lattice.  $Sm^{3+}$  ions in the orthophosphate lattice can exhibit luminescence properties due to their energy level structure [18, 19]. The luminescence properties can be influenced by crystal field effects and the surrounding structure [20,21]. To.

 ${\rm Sm}^{3+}$  activated K<sub>3</sub>La(PO<sub>4</sub>)<sub>2</sub> phosphors have a range of potential applications due to their luminescent properties. In solid-state lighting,  ${\rm Sm}^{3+}$  activated K<sub>3</sub>La(PO<sub>4</sub>)<sub>2</sub> phosphors can be used as luminescent materials in white LED lighting applications. The phosphor may be activated by blue light and its red emission can be combined with other colors to produce white light.  ${\rm Sm}^{3+}$  activated K<sub>3</sub>La(PO<sub>4</sub>)<sub>2</sub> phosphors can be used in display technologies, such as plasma displays, to produce orange and red emissions. The phosphors can also be used in color filters and backlighting for LCD displays [22,23]. The orange-red emission from  ${\rm Sm}^{3+}$  activated K<sub>3</sub>La(PO<sub>4</sub>)<sub>2</sub> phosphors can be used in biomedical imaging applications, such as fluorescence microscopy and bio-imaging, to label and detect biological molecules.  ${\rm Sm}^{3+}$  activated K<sub>3</sub>La(PO<sub>4</sub>)<sub>2</sub> phosphors have been studied for their potential use in radiation

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#### Abhimanyu P. Pawar<sup>1</sup>, Kishor S. Naktode<sup>1</sup>, Arvind J. Mungole<sup>2</sup>

#### Green synthesis of silver nanoparticles from whole plant extract analyzed for characterization, antioxidant, and antibacterial properties

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In this analysis, a green synthesis method utilizing a plant extract derived from *Rumex nepalensis* (Spreng.) was employed to synthesize silver nanoparticles. The synthesized nanoparticles were thoroughly characterized for their structural, surface morphological, optical, antioxidant, and antibacterial properties. Structural analysis revealed a face-centered cubic structure, while FTIR analysis confirmed the presence of biosurfactant molecules in the leaf extract that acted as reducing agents. SEM and TEM analyses further confirmed the spherical shape of the nanoparticles, with a size range of 19-28 nm. The evaluation of the silver nanoparticles demonstrated their antioxidant and antibacterial properties. These nanoparticles exhibited activities in both antioxidant and antimicrobial realms, showcasing their potential as dual-functional agents. This study highlights the effectiveness of the green synthesis method using *Rumex nepalensis* (Spreng.) extract for the production of silver nanoparticles with desirable properties for various applications.

Keywords: Green synthesis, Plant extract, silver nanoparticles, Antibacterial activity, Antioxidant activity.

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#### Introduction

In the past century, Nanoscience and nanotechnology are recognized as major focal points in materials science research. These fields involve the production of nanoparticles, which are particles with a size of less than 100 nm [1]. Nanoparticles can act as building blocks for various physical and biological systems, opening up new opportunities in fields such as medicine, electronics, and energy. They exhibit novel properties that are maintained with particular features like morphology, shape, and size [2]. As a result, nanotechnology has contributed to the development of biosensors, space technology, polymers, ceramics, biomedicine, catalysis, cosmetics, [3-9] and many more, leading to advancements and improvements in various industries. Metal-based nanoparticles have become increasingly popular in various fields due to their unique physicochemical properties. Platinum, Titanium Oxide, Copper Oxide, Magnesium Oxide, Palladium,

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Gold, Iron Oxide, etc. are some of the widely used metalbased nanoparticles. These nanomaterials have shown promising results in applications such as drug delivery. imaging, tissue engineering, and plant growth promotion. Researchers from diverse fields have been also shown interest towardthe zero-valent metals nanoparticle like Ag, Fe, and Zn with potential applications [10-11]. Their antimicrobial properties make them a suitable candidate for disinfection and sterilization purposes [12]. Additionally, their unique optical and electrical properties make them ideal for use in electronic devices and sensors [13]. With their numerous applications, silver nanoparticles hold great potential for advancing technology and improving the quality of life. The formation of silver nanoparticles has been studied through diverse approaches, including chemical, physical, and biological methods [14]. However, silver nanoparticles synthesis using physical and chemical methods has some drawbacks, such as the use of expensive instruments, poor cost-effectiveness, high energy requirements, and the use **Research Article** 

# Nano Riomed Eng

#### Biosynthesis of CuO Nanoparticles Using Plant Extract as a Precursor: Characterization, Antibacterial, and Antioxidant Activity

Pawar Abhimanyu<sup>1™</sup>, Mungole Arvind<sup>2</sup>, Naktode Kishor<sup>1</sup> <sup>1</sup>Department of Chemistry, NevjabaiHitkarini College, Bramhapuri, Maharashtra 441 206, India <sup>2</sup>Department of Botany, NevjabaiHitkarini College, Bramhapuri, Maharashtra 441 206, India

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#### Abstract

Biosynthesis of metal nanoparticles presents a promising approach for their efficient and environmentally friendly production. In this study, CuO nanoparticles were successfully synthesized by using Rumex nepalensis Spreng. as a bio-reducing agent. The spectroscopic analysis confirmed the crystalline monoclinic structure of the synthesized CuO NPs, with particle sizes ranging from 21 to 97 nm. These biosynthesized CuO NPs exhibited notable antimicrobial activity against diverse microorganisms, suggesting their potential for antimicrobial applications. Moreover, the CuO NPs displayed significant antioxidant activity, demonstrated by their effective scavenging of 1,1-Diphenyl-2-picrylhydrazyl (DPPH) free radicals. This study highlights the straightforward, cost-effective, nontoxic, and robust nature of CuO NPs synthesis using Rumex nepalensis Spreng., offering insights into their potential applications in antimicrobial and antioxidant fields.

Keywords: antimicrobial activity; antioxidant activity; X-ray diffraction (XRD); transmission electron microscopy (TEM); CuO nanoparticles (NPs)

#### Introduction

Numerous particles of varying shape and size exist on Earth, and those falling within the 1-100 nm (nanometer) range are classified as nanoparticles (NPs) [1]. Nanotechnology, a field focused on designing environmentally friendly synthesis methods, faces challenges in nanoparticle characterization and application. By manipulating materials at the atomic level, nanotechnology enables the creation of nanostructured materials with unique properties tailored for specific functions [2]. Nanomaterials serve as

fundamental building blocks and have garnered attention due to their wide-ranging impact in fields such as cosmetics, energy, antimicrobial agents, electronics, food and agriculture, medicine, paints, polymers, textiles, and catalysis [3, 4]. As a result, researchers are increasingly interested in nanoparticle synthesis. Various synthesis methods, including chemical electrochemical techniques such as reduction, sonochemical methods. thermal decomposition, chemical precipitation, microwave irradiation, gas phase evaporation, and sol-gel processes, have been employed to control the size and shape of synthesized CuO nanoparticles. However, these methods have drawbacks DOI: 10.1002/fedr.202300023

#### SHORT COMMUNICATION

Bevised: 12 October 2023

## Delgadoana, a new replacement name for Delgadoa F.S.Santos, Snak & L.P.Queiroz (Phaseolinae: Leguminosae)

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#### Abstract

The name of a newly described monotypic genus of woody lianas, *Delgadoa* F.S.Santos, Snak & L.P.Queiroz from Bahia is an illegitimate name because of later homonym of fossil Pteridophyte genus *Delgadoa* Heer, and hence according to article 53.1 of the International Code of Nomenclature for algae, fungi, and plants (ICN), a new name *Delgadoana* U.B.Deshmukh, M.B.Shende, E.S.Reddy & Mungole is proposed here along with a new combination for *D. bambuicola* F.S.Santos, Snak & L.P.Queiroz.

#### KEYWORDS

Delgadoa, fossil, homonym, illegitimate, Leguminosae, Pteridophyte

#### **1** | INTRODUCTION

Recently, da Santos Silva et al. (2022) on the basis of phylogenetic analyses of nuclear ITS and plastid trnK/matK sequences demonstrated that the taxon represents a new Sigmoid-keel clade within subtribe Phaseolinae, sister to the genus *Sigmoidotropis* (Piper) A. Delgado and *Ancistrotropis* A. Delgado. da Santos Silva et al. (2022) described new monotypic genus of woody lianas in Sigmoid-keel clade, *Delgadoa* F.S.Santos, Snak & L.P.Queiroz with type species *D. bambuicola* F.S.Santos, Snak & L.P.Queiroz from Bahia.

However, the generic name *Delgadoa* had previously been used in botanical nomenclature of fossil Pteridophyte genus *Delgadoa* Heer described from Portugal with two species *D. occidentalis* Heer, the type species (Andrews, 1955) and *D. elegans* (Zigno) Heer. Therefore, the recently described living angiosperm genus *Delgadoa* F.S.Santos, Snak & L.P.Queiroz is an illegitimate later homonym of fossil Pteridophyte genus *Delgadoa* Heer, according to Art. 53.1 of (Turland et al., 2018). Therefore, a new name to replace *Delgadoa* F.S.Santos, Snak & L.P.Queiroz is proposed below, as well as a new combination for type *D. bambuicola* F.S.Santos, Snak & L.P.Queiroz.

Delgadoana U.B.Deshmukh, M.B.Shende, E.S. Reddy & Mungole, nom. nov.

Replaced name: Delgadoa F.S.Santos, Snak & L.P.Queiroz, Taxon 72(1); 72.2022 (2023), nom. illeg. (Art. 53.1 of ICN), non Delgadoa Heer (1881: 6), Contr. Fl. Foss. 6.1881.

• **Type:** *Delgadoana bambuicola* (F.S.Santos, Snak & L.P.Queiroz.) U.B.Deshmukh, M.B.Shende, E.S.Reddy & Mungole, comb. nov.

**Eponymy:** The generic name honors to Professor Dr. Alfonso Delgado-Salinas, a Mexican botanist distinguished by his studies on the systematics of the Phaseolinae.

Delgadoana bambuicola (F.S.Santos, Snak & L.P.Queiroz) U.B.Deshmukh, M.B.Shende, E.S.Reddy & Mungole, comb. nov.

Basionym: Delgadoa bambuicola F.S.Santos, Snak & L.P.Queiroz, *Taxon* 72(1); 72.2022 (2023).

**TYPE:** BRASIL. Bahia, Santa Maria da Vitória, 13°18′15″ S, 44°06′56.8″ W, elev. 600 m, 11 Feb 2018, F.S.Santos, C.Snak, C.Silva & F.G.Oliveira 60 (holotype HUEFS barcode HUEFS000289559; isotypes: HUEFS barcode HUEFS000233911, to be sent to K, MEXU, NY, P, RB).

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#### A review of recent synthetic strategies and biological activities of isoxazole

Chandrashekhar P. Pandhurnekar 🐹, Himani C. Pandhurnekar, Arvind J. Mungole, Suraj S. Butoliya, Babita G. Yadao

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#### Abstract

Among different heterocyclic compounds, isoxazole and their analogues are very important classes of heterocyclic compounds as they display an extensive range of biological actions. This makes such scaffolds very important structures in the field of medicinal chemistry. From an extensive literature assessment, isoxazole is clinically proven to be very effective as an anti-bacterial, anti-fungal, antiinflammatory, anti-cancer, anti-tubercular, and anti-neoplastic agent. The different derivatives of isoxazole which exhibits adjustment in their structure have shown a high degree of variety in their medicinal properties which makes evident them as very beneficial in the progress of novel bioactive drugs which show enhanced effectiveness along with minor harmfulness. Structural aspects of isoxazole having aromaticity with weaker nitrogen-oxygen bonding provide a potential site for the ring cleavage. Thus, this isoxazole ring system allows easier modifications of substituents in their ring structure which consequently make isoxazole very useful intermediates in various synthetic routes of bioactive compounds. Hence, the synthesis and evaluation of isoxazole-containing molecules with wider therapeutic consequences are always the topic of interest for chemists. Hence, in light of this comprehensive research on isoxazole, it is thought worthwhile to review various pathways for the synthesis of isoxazole analogues and having a broad spectrum of bioactive actions.

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# (III)

# Ethnobotanically Important Herbaceous Flora of Seminary Hills, Nagpur

Documentation of traditional knowledge on ethnomedicinal use of plants has been considered as a high priority area to support the discovery of drugs benefitting mankind (Cherian and Ramteke, 2010). Ethnomedicinal plants, since times immemorial, have been used in virtually all cultures as a source of medicine. The widespread use of herbal remedies and healthcare preparations, as those described in ancient texts such as Vedas and the Bible, which were obtained from plants has been traced to the occurrence of natural products with medicinal properties. The plants have been the important source of medicines used by man from prehistoric times for relieving suffering and curing ailments. The need for the integration of local indigenous knowledge for a sustainable management and conservation of natural resources received more and more recognition (Posey, 1992). A medicinal plant is any plant used in order to relieve, prevent or cure a disease or to alter physiological and pathological process or any plant employed as a source of drugs or their precursors (Arias, 1999). 'Health is dearer than wealth' as quoted by Hamilton (1997); so, the medicinal plants are of great value.

According to an All India Ethnobiological survey carried out by the Ministry of Environment and Forests, Government of India, there are over 8000 species of plants being used by the people of India for different ailments (Archana *et al.*, 2011). This indicates that the medicinal plants have been brought in the main stream from folk medicines.

#### Study Area-Seminary Hills

The selected study area Seminary Hills is located with latitude 21°9'57"North and Longitude 79°3'47" East. Total area of Seminary Hills Reserve forest is 174.97 Acres, which includes 8.40 Acres of Deforestation area (Government Notification No. 372-1502 XI of 43, Date 30/3/1944).

Extensive and intensive visits were arranged to various regions of study area in different seasons. The plants were observed in their natural habitat and the Ethnomedicinal data was collected and recorded in the field diary. The multiple specimens of plants in flowering and fruiting state were collected, preserved and their herbarium sheets were prepared. The field notes were incorporated with the specimens on the herbarium sheets and stored in Herbarium of Department of Botany, Dharampeth M. P. Deo Memorial Science College, Nagpur. Ethnobotanical information was collected from the local people and Ayurvedic practitioners. The ethnobotanical evidences were searched and recorded from the available literature.

During the study, 67 plant species recorded from the study area were found as ethnobotanically important (Table 1). These species belonged to 25 families (Fig. 1). Herbaceous flora is dominant as compared to the shrubs, climbers and trees. It was observed that the herbaceous flora is more favored in the treatment of various diseases or disorders (Table 1).

Most of the known ethnobotanically important plants species belonged to family Fabaceae, Asteraceae, Acanthaceae and Malvaceae. Medicinal plants are generally used in crude form; this indicates various chemical constituents are present in specific plant. Hence most of the medicinally known plants are found effective against various diseases (Table 1, Fig. 3).

In present study, leaves of the plants were found to be most useful part in the disease treatment (Fig. 2). In case of the herbaceous flora, whole plants are useful in the treatment. But in other cases, most frequently useful plant part is leaves, fruits and seeds and followed by



Fig.1: Representation of different medicinally important taxa from Seminary Hills, Nagpur



Fig. 2: Distribution of the taxa based on plant part of medicinal importance



Fig. 3: Distribution of taxa based on medical efficacy in diseases/disorders.

#### roots or root tubers, flowers, bark, and latex (Fig. 2).

Traditionally, this treasure of knowledge has been passed on orally from generation to generation without any written documentation and is still retained by various indigenous groups around the world (Perumal Samy and Ignacimuthu, 2000; Saranraj *et al.*, 2016). Traditional folk medicine uses the knowledge, skills and practices based on the theories, beliefs and experiences of indigenous people to its cultures for maintenance of health. Documenting the indigenous knowledge through ethnobotanical studies is important for the conservation and utilization of biological resources. Ethnobotanical survey has been found to be one of the reliable approaches to drug discovery (Fabricant and Farnsworth, 2001; Kolanjinathan and Saranraj, 2015). The consumption, management and valuation of wild plants are central aspects of the traditional knowledge in many human populations. Thus, plants gathering, the diffusion and conservation of knowledge within the community are traditional practices that have contributed to the subsistence of many cultures. In most of the societies the medical system coexists with several traditional systems. These traditional medical systems are generally based on the uses of natural and local products which are commonly related to the people's perspective on the world and life (Saranraj *et al.*, 2016).

In the present study plant species belonging to 25

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#### Table 1: Plant species with respect to ethnobotanical uses

Sr. No.	Botanical name of the plant	Family	Accession No.	Ethnobotanical Uses
1	Acalypha ciliata Eoresk	Euphorbiacoao	DTH/NG/058	Mached leaves are applied on sores
2	Acalypha indica L.	Euphorbiaceae	PTH/NG/1547	Leaves and latex of the plant are used in treatment of
3	Ageratum conyzoides L.	Asteraceae	PTH/NG/1460	Against dysentery, diarrhoea.
	Alle and the second second Karalle	Americally and a	DTUNICHO22	Juice of nowers is used against scaples.
4	Alternanthera pungens Kunth	Amaraninaceae.	PTH/NG/1033	Leaves are used in rever and diarmea.
5	Arn.	Fabaceae	PTH/NG/1522	are chewed in fever.
6	Alysicarpus vaginalis (L.) DC.	Fabaceae	PTH/NG/490	Seeds are used as anti-inflammatory and as an antidote to snake bite.
7	Anisomeles indica (L.) O. Ktze.	Lamiaceae	PTH/NG/1167	Leaves juice used in Dyspepsia and fever.
8	Antigonon leptopus Hook. &Arn.	Polygonaceae	PTH/NG/500	Leaves used in skin problems also in cough, pain and diabetes.
9	Asystatia gangetica (L) T. Ander.	Acanthaceae	PTH/NG/2223	Flowers used in dry cough and chest discomfort.
10	Bidens hiternata (Lour.)	Asteraceae	PTH/NG/1680	Fruits are inflammation leprosy ulcers and diarrhoea
10	Merr & Sherff	7.010100000	1 minor tooo	Also used in malaria
11	Biophytum sensitivum (L.) DC.	Oxalidaceae	PTH/NG/1050	Decoction of roots is used to treat gonorrhoea and stones in blodder.
40	Diastania servera (Vishi) Deth	Aconthecese	DTU/NC/4442	Sooda ara diyaa ta ajak goata
12	Biephans repens (Vani) Roth	Acanthaceae	PTH/NG/TTTZ	Seeds are given to sick goals.
13	Boernavia repens L.	Nyclaginaceae	PTH/NG/784	Whole plant is used against anemia and liver diseases.
14	Calotropis gigantea (L.) Ait.	Asclepiadaceae	PTH/NG/1698	Roots of the plant used against diarrhoea and constipation
15	Cassia absus L.	Fabaceae	PTH/NG/1558	Leaves are used as an antiseptic.
16	Cassia tora L.	Fabaceae	PTH/NG/2217	Seeds are used in cough and dysentery.
17	Cissus woodrowii (Stapf ex T.	Vitaceae	PTH/NG/1240	To treat pain and to repair bone fractures.
	Cooke) Sant.			Also used against allergies, asthma and gout.
18	Cleome viscosa L.	Cleomaceae	PTH/NG/1107	Decoction of roots is used in fever.
19	Clitoria ternatea L.	Fabaceae	PTH/NG/726	Leaves are used for natural dyes, treatment of snake bites,
20		Quantitagaga	DTU/NC/042	Eruit is used to treat loproou four asthms and branchitic
20	Coccinia granuis (L.) Voigt	Cucurbitaceae	PTH/NG/643	Prote is used to treat reprose, rever, astrina and bronchus.
21	Commelina benghalensis L.	Commelinaceae	PTH/NG/663	Bark is used in dysentery, leprosy etc.
22	Commelina diffusa Burm. f. sp.	Commelinaceae	PTH/NG/1805	and rashes.
23	Corchorus aestuans L.	Tiliaceae	PTH/NG/1255	Leaves are used in demulcent, diuretic and tonic. Also used in gonorrhea and dysuria.
24	Crossandra infundibuliformis (L.) Nees.	Acanthaceae	PTH/NG/2214	Flowers are used in fever and also in headache.
25	Crotalaria hirta Wild. sp.	Fabaceae	PTH/NG/1432	Seeds are use in gout, pain, swellings, cuts, wounds and coughing.
26	Datura inoxia Mill.	Solanaceae	PTH/NG/1725	Leaves are psychoactive
27	Desmodium triflorum (L.) DC.	Fabaceae	PTH/NG/1013	Leaves are used in dry cough
28	Didera muricata (L.) Mart	Amaranthaceae	PTH/NG/1313	Fruits used in cough and dysentery
29	Dipteracanthus prostratus (Poir.)	Acanthaceae	PTH/NG/1795	Roots are antidote against snake bites by tribal people.
	Nees			
30	Emilia sonchifolia (L.) DC.	Asteraceae	PTH/NG/2157	Traditionally used in fever, sore throat, diarrhoea, eczema and snakes bites.
31	Euphorbia heterophylla L.	Euphorbiaceae	PTH/NG/2213	Latex is used against dysentery. Decoction of whole plant is used in bronchial infections and asthma.
32	Euphorbia hirta L.	Euphorbiaceae	PTH/NG/1277	Leaves and latex is used against dysentery.
33	Evolvulus alsinoides (L.) L.	Convolvulaceae	PTH/NG/1576	It is used against diarrhoea.
34	Gomphrena serrata I	Amaranthaceae	PTH/NG/1598	It is used in bronchial asthma. It is also used in whooping
0.5		D L'	DTUMO/444	Cough.
35	Hedyotis corymbosa (L.) Lam.	Rubiaceae	PTH/NG/1141	Leaves are used to treat sores, wounds. Roots are used by Chinese for improved blood circulation.
36	<i>Hibiscus lobatus</i> (J. A. Murr.) O. Ktze.	Malvaceae	PTH/NG/1711	Roots with turmeric are used to cure dysentery and stomachache. Treats anorexia in cattle.
37	Hybanthus enneaspermus (L.) F. v. Muell.	Violaceae	PTH/NG/1739	Decoction of whole plant roots is used to treat urinary infection.
38	Hyptis suaveolens (L.) Poit.	Lamiaceae	PTH/NG/2138	Seeds are used to make refreshing drinks. Seed are also use in beverages.
39	Indigofera linnaei Ali	Fabaceae	PTH/NG/737	Leaves are used in nervous disorder and asthma. Also as an ointment for curing skin diseases. Roots are use in toothache, syphilis and kidney stones.

#### Research Notes

40	Indoneesiella echioides (L.) Sreem.	Acanthaceae	PTH/NG/1179	Leaves and roots are mixed with mustard oil to apply on snake bites.
41	Ipomoea triloba L.	Convolvulaceae	PTH/NG/1390	Decoction is used in fever, dysentery and liver disorders. Leaves of some species such as <i>l.batatus</i> are eaten as vegetable.
42	Justicia adhatoda L.	Acanthaceae	PTH/NG/805	Whole plant used in Unani, Homoeopathic and Ayurvedic medicines.
43	Lantana camara L.	Verbenaceae	PTH/NG/1338	Fruits are edible having sweet taste.
44	Martynia annua L.	Martyniaceae	PTH/NG/2107	In making beads and also in Ayurveda.
45	Oxalis corniculata L.	Oxalidaceae	PTH/NG/1218	Whole plant is used in treatment of fever.
46	Parthenium hysterophorus L.	Asteraceae	PTH/NG/2127	In medicines to treat diarrhoea, fever. Leaves are also used in neurological disorders, urinary tract infection etc.
47	Pentanema indicum (L.) Ling.	Asteraceae	PTH/NG/2132	Leaves of the plants used in treatment of skin infections.
48	Pergularia daemia (Forssk.) Choiv.	Asclepiadaceae	PTH/NG/2214	Seeds of the plant used in treatment of liver.
49	Phyllanthus fraternus Webster	Phyllanthaceae	PTH/NG/1763	Seeds of the plant are used in problems of stomach, liver, kidney and spleen.
50	Physalis minima L.	Solanaceae	PTH/NG/1750	Fruit is nutritious and used in eatables.
51	Ruellia tuberosa L.	Acanthaceae	PTH/NG/1434	Bark used in treatment of wound and urinary tract infection.
52	Rungia pectinata (L.) Nees	Acanthaceae	PTH/NG/1169	Leaves of the plant used against inflammation, Diuretic and microbial activities.
53	Sesamum orientale L.	Pedaliaceae	PTH/NG/745	Seeds are used for medicinal and nutritive value, as they are rich in omega-6.
54	<i>Sida acuta</i> Burm. f.	Malvaceae	PTH/NG/1110	Roots are used in treatment of urinary diseases and blood disorders. Also in nervous disorders. Used as mild sedative
55	Sida cordifolia L.	Malvaceae	PTH/NG/1756	Whole plant boosts immunity. It helps heal injuries in sore muscles and joints.
56	Sida rhombifolia L.	Malvaceae	PTH/NG/1675	Fruits are used to relieve headache. Leaves are used in swelling. Roots used in rheumatism.
57	Spermacoce articularis L. f.	Rubiaceae	PTH/NG/746	Leaves used in bronchial asthma.
58	Synedrella nodiflora (L.) Gaertn.	Asteraceae	PTH/NG/1397	Leaf juice used in earache and stomachache.
59	Tephrosia purpurea (L.) Pers.	Fabaceae	PTH/NG/1219	Decoction of roots is given against intestinal worms, diarrhoea, rheumatism and urinary infection.
60	Teramnus labialis (L.f.) Spreng.	Fabaceae	PTH/NG/1538	It is used against rheumatism and stomachache.
61	Trichodesma inaequale Edgew.	Boraginaceae	PTH/NG/1227	Leaves are used against diarrhoea, dysentery and skin diseases.
62	Trichosanthes cucumerina L.	Cucurbitaceae	PTH/NG/1020	Fruits are good source of vitamins and minerals.
63	Tridax procumbens L.	Asteraceae	PTH/NG/2133	Whole plant is used in wound healing and as an anticoagulant. It is used in ayurvedic medicines for liver disorders.
64	Triumfetta rhomboidea Jacq.	Tiliaceae	PTH/NG/1083	Decoctions of roots are used for ulceration. Also use in dysentery, diarrhea and internal hemorrhages.
65	Urena lobata L.	Malvaceae	PTH/NG/1327	Root decoction used in rheumatism, enteritis and dysentry. Leaves are used in bladder and intestinal infection.
66	Vernonia cinerea (L.) Less.	Asteraceae	PTH/NG/1357	Leaves are used in malarial fever. Also used to cure diseases caused by ringworms and tapeworms.
67	Vigna trilobata (L.) Verdc.	Fabaceae	PTH/NG/963	Leaves and seeds applied to treat swelling and skin infections.
				Leaves are chewed to treat tooth ailments.

families of angiosperms known for different ailments were reported. The present investigation revealed that the medicinal plants found in wild in Seminary Hills have played a vital role in the primary health care of the people. The reported results are encouraging but scientific scrutiny is necessary before being put in practice.

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# BIOSYNTHESIS OF COPPER OXIDE NANOPARTICLES USING Uraria picta (JACQ.) PLANT EXTRACT AND ITS CHARACTERIZATION

### SARTAJ SHEIKH<sup>1,</sup> ARVIND J. MUNGOLE<sup>2</sup>\*, HARSHA P. KANFADE<sup>3</sup>, A. P. PAWAR<sup>4</sup>, MRUNAL I. WARHADE<sup>1</sup>, SNEHAL BHANDAKKAR<sup>6</sup> AND A. N. YERPUDE<sup>7</sup>

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#### **KEYWORDS**

Uraria picta Biosynthesis CuO nanoparticles,

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#### ABSTRACT

The complete plant extract from Uraria picta was used in the current study as a natural reagent to synthesize CuO nanoparticles. A large part of the synthesis in response to the olant extract served as a reducing and stabilizing agent, resulting in copper oxide nanoparticles (NPs) of different sizes and forms. The synthesized nanoparticles were characterized using XRD, FTIR, UV-Vis spectroscopy, SEM and TEM. Strong absorbance peaks at 294 nm in the UV-visible spectrum are caused by the formation of CuO. The synthesized CuO XRD diffraction peaks closely matched those of the previously published CuO XRD. According to FTIR studies, the Cu-O bond stretching can be seen in the absorption bands at 515.50 cm-1 and 623.64 cm-1. The SEM micrographs show that the CuO particles are spherically formed, densely packed together, and irregularly dispersed. The TEM picture showed an average particle size of 50 nm. In this study, copper oxide nanoparticles of Uraria picta (JACQ.) plant extract prepared using the biosynthesis and characterized.

#### INTRODUCTION

Biosynthesis of metal oxide nanoparticles, mediated by plant extracts has become a promising area of research due to their intensive applications in the environmental, pharmaceutical, nanofluids food and cosmetics industries (Chang et al., 2011). Biological synthesis has received widespread attention as a reliable, sustainable, and environmentally friendly method for the synthesis of metal or metal oxide nanoparticles (Singh et al., 2018). Nanoparticle biosynthesis is considered to be an important tool in reducing the destructive effects associated with traditional nanoparticle synthesis methods used in laboratories and industries (Jeevanandam, et al., 2016 and Chauke et al., 2020).

Nanoparticles with their unique size-dependent property have the ratio of the surface area to volume. The smaller the sized particles carry a greater aspect ratio *i.e.*, greater surface area compared to their volume. This increasing field of smaller nanoparticles enhances the nanoparticle's reaction with the surrounding molecules. Metal oxides at the nanoscale can restrict the movement of electrons due to their small size. They can tune their band gaps and can therefore control their light absorption and emission wavelengths (Mungole *et al.*, 2021). Potential applications of copper oxide nanoparticles (CuONPs) in field launch transmitters, agriculture, gas sensing, waste treatment, catalysis, batteries, food preservation, hightemperature superconductors, solar energy conversion, photovoltaic devices, dye removal, etc. have been established (Akintelu et al., 2020). Due to CuO nanoparticle's high thermal conductivity, optical, magnetic, and electrical properties (Chandrasekar et al., 2021) researchers are truly attracted to it. Besides these applications, CuONPs also have biomedical activities such as anticancer (Rehana et al., 2017), antimicrobial (Ahamed et al., 2014), and antioxidant as well as catalytic efficacy (Dobrucka et al., 2018). The extensive application in wound healing by copper nanoparticles synthesized by Falcaria vulgaris leaf extract were examined by . Zangeneh, et al., 2019). Weiss et al., reviewed applications of nanoparticles in food nanotechnology also (Weiss et al., 2006). Presently nanoparticles of various metals using different plants are synthesized with different goals (Pawar et al., 2023; Dandapat et al., 2023., Padhiary et al., 2023).

For the synthesis of CuONPs, physical and chemicals methods used traditionally might be a tedious process (Akintelu et al., 2021) and can give rise to hazardous chemical by-products (Ananda Murthy et al., 2018). On the contrary, the biosynthesis of CuO nanoparticles has been carried out by various biological materials like bacteria, fungi, alga, and plant extract. Among all these methods of biosynthesis of copper oxide nanoparticles, the plant extract mediated approach is a comparatively simple and easy process to produce nanoparticles at a larger scale to bacteria and fungi-mediated



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# इतिहासाचार्य वि. का. राजवाडे मंडळ, धुळे या संस्थेचे त्रैमासिक ॥ संशोधक॥

पुरवणी अंक ३ - सप्टेंबर २०२३ (त्रैमासिक)

शके १९४५
वर्ष : ९१
पुरवणी अंक : ३

#### संपादक मंडळ

• प्राचार्य डॉ. सर्जेराव भामरे • प्रा. डॉ. मृदुला वर्मा • प्रा. श्रीपाद नांदेडकर

#### \* प्रकाशक \*

श्री. संजय मुंदडा कार्याध्यक्ष, इ. वि. का. राजवाडे संशोधन मंडळ, धुळे ४२४००१ दूरध्वनी (०२५६२) २३३८४८, ९४०४५७७०२०

कार्यालयीन वेळ सकाळी ९.३० ते १.००, सायंकाळी ४.३० ते ८.०० (रविवारी सुट्टी)

मूल्य रु. १००/-वार्षिक वर्गणी रु. ५००/-, आजीव वर्गणी रु. ५०००/- (१४ वर्षे)

विशेष सूचना : संशोधक त्रैमासिकाची वर्गणी चेक/ड्राफ्टने 'संशोधक त्रैमासिक राजवाडे मंडळ, धुळे' या नावाने पाठवावी.

अक्षरजुळणी : सौ. सीमा शिंत्रे, वारजे-माळवाडी, पुणे ५८.

महाराष्ट्र राज्य साहित्य आणि संस्कृती मंडळाने या नियतकालिकेच्या प्रकाशनार्थ अनुदान दिले आहे. या नियतकालिकेतील लेखकांच्या विचारांशी मंडळ व शासन सहमत असेलच असे नाही.

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#### Enhancing Women's Financial Empowerment: (An Investigation into Investment Preferences and Awareness Among Working Women Before and After the Covid-19 Pandemic)

Prof Kaushik Save Ph.D scholar, Gondwana University, Gadchiroli Dr. Bhaskar L. Lengure Associate Professor, N.H. College, Bramhapuri,Chandrapur

#### Abstract:

This quantitative study examines changes in investment preferences, awareness, behavior, and financial decision-making among 120 working women before and after the Covid-19 pandemic. Ethical considerations were maintained, using SPSS for analysis. Post-pandemic, investment preferences increased, awareness of options improved, and behavior and decisions were more strategic. The study has implications for policy, institutions, and education, showing adverse events can positively impact women's financial empowerment through tailored literacy programs and inclusive products. The study's empirical evidence contributes to understanding how the pandemic influenced working women's financial strategies, offering insights into their responses to economic shocks.

**Keywords:** Women's Financial Empowerment, Investment Preferences, Awareness, Investment Behavior, Covid-19 Pandemic, Gender Equality,

#### Introduction :

Financial empowerment is crucial for achieving gender equality, yet women often face unique challenges in attaining financial independence and security. Gender equality relies on financial empowerment, but women encounter unique barriers despite increased workforce participation. The Covid-19 pandemic may have worsened these challenges, impacting women's financial choices. Existing research indicates women's greater risk aversion compared to men (Felton et al., 2003; Dohmen et al., 2011). Pandemic-induced economic turmoil caused shifts in financial behavior (Cene, 2021; Spinelli et al., 2021), potentially influencing women's investment decisions and prompting the need for examination.

#### **Research Questions :**

The study's research questions encompass various aspects:

- 1. Evolution of investment preferences among working women before and after Covid-19.
- 2. Awareness of investment options before and after Covid-19.
- 3. Changes in investment behavior during and post Covid-19.
- 4. Impact of the pandemic on financial decision-making of working women.
- 5. Insights and recommendations for enhancing women's financial empowerment and inclusivity.

#### **Review of Literature :**

The provided collection of studies focuses on various aspects of women's investment behavior, financial decision-making, and related factors. Here's a summary of the key findings and themes:

 Investment Preferences and Attitudes: Several studies (Jothilingam & Kannan, 2013; Pankhuri Agarwal, 2020; Kappal & Rastogi,2020) delve into women's investment preferences, showcasing that
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# इतिहासाचार्य वि. का. राजवाडे मंडळ, धुळे या संस्थेचे त्रैमासिक || संशोधक||

पुरवणी अंक ३ – सप्टेंबर २०२३ (त्रैमासिक)

• शके १९४५ • वर्ष : ९१ • पुरवणी अंक : ३

# संपादक मंडळ

• प्राचार्य डॉ. सर्जेराव भामरे • प्रा. डॉ. मृदुला वर्मा • प्रा. श्रीपाद नांदेडकर

## अतिथी संपादक

• डॉ. विवेक जोशी • डॉ. वैभव मसराम

## \* प्रकाशक \*

# श्री. संजय मुंदडा

कार्याध्यक्ष, इ. वि. का. राजवाडे संशोधन मंडळ, धुळे ४२४००१ दुरध्वनी (०२५६२) २३३८४८, ९४०४५७७०२०

## कार्यालयीन वेळ

सकाळी ९.३० ते १.००, सायंकाळी ४.३० ते ८.०० (रविवारी सुट्टी)

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विशेष सूचना : संशोधक त्रैमासिकाची वर्गणी चेक/ड्राफ्टने 'संशोधक त्रैमासिक राजवाडे मंडळ, धुळे' या नावाने पाठवावी.

अक्षरजुळणी : सौ. सीमा शिंत्रे, वारजे-माळवाडी, पुणे ५८.

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पुरवणी अंक ३ - सप्टेंबर २०२३

# Women in Bama's Sangati: A Critical Perspective

Shital Nandkishor Chavan Research Scholar

#### Dr. Sunil G. Chaudhari

Guide, Associate Professor N. H. College, Bramhapuri, Dist. Chandrapur, Maharashtra

#### Abstract :

The paper explores Bama's Sangati from the feminist perspective. It also endeavors to depict condition of women especially dalit women in the Indian society. 'Feminism' exclusively deals with the place of women in the family and culture of different kinds. The term 'Feminism' is come from 'Feminine' that refers to appropriate to female sex. The various religions and cultures across the world have developed and fostered views regarding women's position in their religions and cultures. The history of Indian social and cultural ethos is required to be known for proper understanding of Bama's novels and their contents on various planes and her female characters in particular. The important texts in Hinduism such as Puranas and Manusmriti which are called as holy and influential fostered the concept of chaturvarnya. Dr. Babasaheb Ambedkar is of the view that, the Hindu social order was composed of four basic varnas: "1) Brahmins or the priestly class, 2) The kshatriya, or military class, 3) The Vaishya, or the merchant class and 4) The Shudra or the artisan and menial class" (2002: 256). But outside of this fourfold varna system lies untouchables. They are a minor, poor and dependent community.

**Key Words:** Feminism, Sangati, Dalit Feminism, Gender, Caste, Class, Exploitation, Humiliation

#### Introduction

Feminism refers to the movement to understand the notion that women must have the

equal privileges and prospects as men do have in society in every sphere. It has been rightly said that feminism is "a platform to demand equality, rights and justice, Feminism's key assumption is that gender roles are pre-determined and the woman is trained to fit into those roles" (Nayar, 2010: 83). Patriarchy considers women as weaker, delicate, and gentler and they need protection and are assigned only household responsibilities. These notions of patriarchy regarding women are constructed in the context of cultures. It has been posited that, "if one wants to understand female's status in work, one has to understand patriarchy" (Das, 2005: 89).

Feminism as a movement started in 1960s. The works of Mary Wollstonecraft, Virginia Woolf and Beauvoir in which the problems of women were avowedly depicted. In A Vindication of the Rights of Women, Mary Wollstonecraft underscored earlier problems of inequality between the sexes. Virginia Woolf talks about the difficulties ladies confront in their life in A Room of one's own. She disallowed the perception of a separate feminist consciousness and wished to achieve a femininity of the unconscious so that there is no conflict between male and female sexuality and an escape from the antagonism of femaleness or maleness. Simon de Beauvoir's monumental work The second Sex reveals that how women are humiliated socio-culturally and emotionally. She articulates: "One is not born a woman but becomes one" (Ruthven, 1984: 267).

पुरवणी अंक ३ - सप्टेंबर २०२३



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इतिहासाचार्य वि. का. राजवाडे संशोधन मंडळ, धुळे या संस्थेचे त्रैमासिक । संशोधक ।

# पुरवणी अंक १५ - डिसेंबर २०२३ (त्रैमासिक)

शके १९४५
 वर्ष: ९१
 पुरवणीअंक: १५

#### संपादक मंडळ

- प्राचार्य डॉ.सर्जेराव भामरे
- प्राचार्य डॉ. अनिल माणिक बैसाणे
- प्रा.डॉ.मृदुला वर्मा
- प्रा.श्रीपाद नांदेडकर

#### अतिथी संपादक

• प्रा.गणेश बेले • प्रा.डॉ.प्रमोद अलोने • प्रा.डॉ.किशोरचंद्र रेवतकर

\* प्रकाशक \*

# श्री. संजय मुंदडा

कार्याध्यक्ष, इ.वि.का. राजवाडे संशोधन मंडळ, धुळे ४२४००१.

दूरध्वनी (०२५६२) २३३८४८, ९४२२२८९४७१, ९४०४५७७०२० ई-मेल : rajwademandaldhule1@gmail.com

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#### कार्यालयीन वेळ

सकाळी ९.३० ते १.००, सायंकाळी ४.३० ते ८.०० (रविवार सुटी)

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# साने गुरुजी यांच्या 'श्यामची आई'मधील मातृप्रेम, वात्सल्य आणि सुसंस्कार

सोनम भरत कुर्रेवार संशोधक विद्यार्थीनी

#### डॉ. धनराज ल. खानोलकर

मार्गदर्शक मराठी विभाग प्रमुख ने. हि. महाविद्यालय, ब्रम्हपुरी, जि. चंद्रपूर

## सारांश :

साने गुरुजी यांच्या सिद्धहस्त लेखणीतून 'श्यामची आई' या अजरामर पुस्तकाची निर्मिती झाली. हे पुस्तक लिहून त्यांनी संपूर्ण जगावर थोर उपकार केले असेच म्हणावे लागेल. साने गुरुजींनी या पुस्तकात एकूण ४२ आठवणी लिहिल्या असून त्यांनी प्रत्येक आठवणीला पहिली रात्र, दुसरी रात्र असे बेचाळीसवी रात्रपर्यंतचे वर्णन केले आहे. तसेच त्यांनी या प्रत्येक रात्रींना साजेसे असे नावही दिले आहे. संस्कार आणि उत्कट प्रेमाने काटोकाट भरलेल्या या रात्री' आयुष्य समृद्धी, संस्कार आणि विकास या आशेच्या किरणांनी अंतर्बाह्य उजळून टाकणाऱ्या आहेत.

श्यामची आई म्हणजे संस्कारांची भरभक्कम शिदोरी होती. जी आधी श्यामच्या आयुष्यभराला पुरली तर आता वाचकांच्या आयुष्यभराला पुरत आहे. श्यामच्या आईने श्यामवर योग्य त्या साऱ्या संस्कारांचे बीजारोपण आयुष्याच्या प्रत्येक टप्प्यावर केले. कधी प्रेम, माया व वात्सल्याचा हात तर कधी छडीचा मार ह्या आईच्या प्रेम करण्याच्या आणि संस्कार करण्याच्या पद्धतीचे किती तरी दाखले आयुष्याला नवे तत्वबोध देऊन जातात. म्हणूनच हे पुस्तक लाखमोलात एक ठरते.

\* बीज शब्द :

साहित्य, आई, संस्कार, वात्सल्य, कृतज्ञता, पत्रावळ. \* प्रस्तावना :

बालमनांवर संस्कार करण्यास मराठी साहित्य क्षेत्राला साहित्याच्या माध्यमातून 'आई' देणारे साने गुरुजी मराठी साहित्यात अजरामर झाले आहेत. साने गुरुजींचे पूर्ण नाव पांडुरंग सदाशिव साने. त्यांचा जन्म दि.२४ डिसेंबर १८९९ ला कोकणातील पालगड, ता. दापोली, जि. रत्नागिरी येथे झाला. यशोदाबाई साने या त्यांच्या आई. त्यांच्यावर वडिलांपेक्षा आईच्या शिकवणुकीचा प्रभाव अधिक होता. म्हणूनच आईच्या संस्कारांनी त्यांचे मातृहृदयी व्यक्तिमत्व घडल्याचे जाणवते. आईच्या संस्कारांसोबतच पुस्तक म्हणजे ज्यातून स्वत:ला साठवावे, आठवावे आणि वाटावेही' या विचारांनी चांगल्या ग्रंथांचेही त्यांच्यावर झालेले संस्कार पुढील काळात त्यांच्या साहित्यलेखनात उमटून दिसतात.

साने गुरुजींनी कथा, कादंबरी, काव्य, लेख, निबंध, चरित्रे इत्यादी साहित्यांच्या विविध क्षेत्रात विपुल असे लेखन केले. त्यांची जवळपास एकूण ७३ पुस्तके प्रकाशित आहेत. त्यांचे 'श्यामची आई' हे पुस्तक तर अख्या महाराष्ट्रातील जनतेने मातृमांगल्याचा ठेवाच असल्याचे मान्य केले.

\* साने गुरुजींची 'श्यामची आई' :-

साने गुरुजींनी साहित्याच्या विविध प्रांतात विशाल मानवतेची शिकवण देणाऱ्या साहित्य निर्मितीत विपुल व अविरत योगदान दिले. 'श्याम', धडपडणारा 'श्याम', 'श्यामची आई' या पुस्तकांतून जणूकाही त्यांनी आपली जीवनगाथाच कथन केली. यापैकी त्यांचे श्यामची आई' हे पुस्तक मराठी भाषेतील अक्षरधन ठरले. माय-लेकरातील प्रेम व संस्कारांच्या हृदयस्पर्शी आठवणी यात साठवल्या आहेत. श्यामच्या बालमनावर जे माणुसकीचे संस्कार त्याच्या आईकडून झाले त्या घटना या अजरामर कलाकृतीत कथन केल्या आहेत.

नाशिकच्या तुरूंगात असताना साने गुरूजींनी या कथा लिहिण्यास दि.९ फेब्रुवारी १९३३ ला सुरुवात केली आणि दि.१३ फेब्रुवारी १९३३ पहाटेपर्यंत अवघ्या पाच रात्रींत त्या लिहून संपविल्या. मात्र अजूनही त्या रात्री कित्येक पिढ्यांवर संस्कार करत आहेत आणि सदैव करत राहणार.

खरे तर ज्या मातेने साने गुरुजींना वाढविले व त्यांच्यावर संस्कार केले. त्या मातेबद्दलचे प्रेम, कृतज्ञताच साने गुरुजींनी या कादंबरीत शब्दरुप केली आहे. संस्कारक्षम पिढी घडविण्याचे महत्त्वपूर्ण कार्य त्यांच्या श्यामची आई' या कादंबरीसोबतच त्यांच्या इतरही कादंबऱ्यांनी केले आहे. विशेषत: त्यांच्या संपूर्ण साहित्यातून आईची महती व मातृभाव हा ओसंडून वाहताना दिसतो. मुळात संस्कारहीन पिढी





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प्रधानमंत्री गरीब कल्याण अन्न योजना की सफलता में सार्वजनिक वितरण प्रणाली कि भूमिका

> गणेश एम. दोनाडकर संशोधक

उच्च शिक्षण व संशोधन केंद्र, ने. हि. महाविद्यालय ब्रह्मपुरी

डॉ. राजू एल. आदे विभाग प्रमुख उच्च शिक्षण व संशोधन केंद्र, ने. हि. महाविद्यालय ब्रह्मपुरी

सारांश :

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वैश्विक महामारी कोविड-१९ के कारण पूरी दुनिया थम सी गई थी। दुनिया का हर नागरिक इस महामारी का शिकार हो चुका था। लॉकडाउन के दौरान देश के नागरिकों, श्रमिकों, किसानों और खेतिहर मजदूरों के हाथ में काम बंद हो जाने के कारण भुखमरी की स्थिति उत्पन्न हो गई थी। इस दौरान देश में सार्वजनिक वितरण प्रणाली ने बहत महत्वपूर्ण भूमिका निभाई है। और कई समस्याओं का सामना करते हुए, इसने प्रत्येक लाभार्थी तक रिकॉर्ड तौर पर अनाज स्टॉक पहुंचाने की चुनौती को पूरा किया है। केंद्र सरकार द्वारा प्रधानमंत्री गरीब कल्याण अन्न योजना की घोषणा की गई थी। शुरुआत में इसकी अवधि अप्रैल से नवंबर २०२० तय की गई थी। इसके बाद इस योजना का विस्तार किया गया। बहुत कठिन समय में भी सार्वजनिक वितरण प्रणाली अब तक बहुत प्रभावी ढंग से कार्य कर रही है। अतः इस दृष्टिकोण से इस शोध पत्र में प्रधानमंत्री गरीब कल्याण अन्न योजना में सार्वजनिक वितरण प्रणाली की भूमिका पर चर्चा की गई है।

बीजशब्द :-

कोविड-१९, प्रधानमंत्री गरीब कल्याण अन्न योजना, सार्वजनिक वितरण प्रणाली

प्रस्तावना :-

भोजन, कपड़ा और मकान मनुष्य की मूलभूत आवश्यकताएँ हैं, जिनमें भोजन पहली प्राथमिकता है। देश या राज्य के लोगों का भूख से मरना या देश के लोगों को जीने के लिए जरूरी भोजन न मिलना सरकार की बड़ी विफलता है। द्वितीय विश्वयुद्ध के बाद जब भारत स्वतंत्र हुआ तो अंग्रेज आये। अतः भारत में अपनी स्थिति मजबूत बनाये रखना बहुत आवश्यक था। इसके लिए उन्होंने भारत में १९४० में बंगाल में पड़े अकाल से निपटने के लिए एक योजना बनाई। इसका नाम है सार्वजनिक वितरण प्रणाली। सार्वजनिक वितरण प्रणाली की शुरुआत १९३९ में मुंबई में पहली राशन दुकान खुलने के साथ हुई थी। प्रशासनिक और वित्तीय प्रवाह को रोकने के लिए ऐसी व्यवस्था बनाना जरूरी था और देश में लगातार पड़ रहे सूखे से निपटने के लिए भी प्रशासनिक व्यवस्था में ऐसी व्यवस्था लाना जरूरी था। १९४३ में राशन की दुकानों का विस्तार तेरह शहरों तक किया गया। भारत के कुछ गांवों और ७७१ शहरों तक पहुंचने में इसे १९४६ का समय लग गया। पीडीएफ यानी सार्वजनिक वितरण प्रणाली ने भारत को आज़ादी के बाद के कई सूखे से उभरने में एक सशक्त शक्ति बना दिया। तब से लेकर आज तक देश में हर आपदा से निपटने में सार्वजनिक वितरण प्रणाली ने अहम भूमिका निभाई है।

संशाधितः

शोध की आवश्यकता :

आजादी के पहले से और आजादी के बाद भी, देश में हाशिये पर पड़े लोगों को उचित मूल्य पर खाद्यान्न उपलब्ध कराने के लिए सरकार के माध्यम से सार्वजनिक वितरण प्रणाली बहुत अच्छा काम कर रही है। कोविड-१९ के कारण पूरे देश को आर्थिक संकट का सामना करना पड़ा और इसके कारण भूख, अकाल, बेरोजगारी जैसे कई संकटों का सामना करना पड़ा और इसे दूर करने के लिए केंद्र सरकार ने प्रधानमंत्री गरीब कल्याण योजना की घोषणा की। इस योजना के कार्यान्वयन में सार्वजनिक वितरण प्रणाली एक महत्वपूर्ण कारक बन गई है। अत: में सार्वजनिक वितरण प्रणाली की भूमिका का अध्ययन एवं शोध करने की आवश्यकता है। प्रधानमंत्री गरीब कल्याण योजना की सफलता में सार्वजनिक वितरण प्रणाली की भूमिका का अध्ययन करते हुए कुछ महत्वपूर्ण उद्देश्यों को ध्यान में रखकर शोध पत्र तैयार किया गया है। १. सार्वजनिक वितरण का अध्ययन करना।

पुरवणी अंक-१३. डिसेंबर २०२३

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# ISSN: 2348-8425 SATRAACHIEE

UGC Care Enlisted, Peer Reviewed research Journal Issue 26, Vol. 38, No. 3, Jan-March, 2023

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# AN EMPIRICAL STUDY ON INVESTMENT PREFERENCES AND AWARENESS LEVEL BEFORE AND AFTER COVID-19

O Prof. Kaushik Save\*O Dr. Bhaskar L. Lengure\*\*

#### Abstract:

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The present study tries examining the investment preference and awareness level before and covid -19. The objective of study is to seeks to identify the investment preferences of individuals before and after the COVID-19 pandemic, to analyze the awareness levels of individuals regarding investment options before and after the COVID-19 pandemic. And to compare the investment preferences and awareness levels of individuals before and after the COVID-19 pandemic. This study will employ a survey-based research design to collect data from a sample of 100 respondents. The respondents will be selected using a convenience sampling technique. Based on this interpretation, one can conclude that the pandemic has motivated investors to explore new investment opportunities and seek expert guidance and has also enhanced their knowledge and awareness of different investment options. The finding suggests that the respondents had lower investment preferences after COVID-19 than before COVID-19. This study suggests that the respondents had similar awareness levels before and after COVID-19.In conclusion, the pandemic has motivated investors to explore new investment opportunities and seek expert guidance while also changing their preferences and decision-making processes.

Keywords: Investment preferences, Awareness level, Covid-19

#### 1. Introduction:

The COVID-19 pandemic has disrupted the global economy, causing widespread economic uncertainty and volatility in financial markets. As a result, individuals have had to adjust their investment strategies to adapt to the new reality of the pandemic. The outbreak of Covid-19 in early 2020 has significantly impacted global economies and financial markets, leading to increased uncertainty and volatility. This has also affected individuals' investment

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> Guest Editor Baldeo B. Kakde

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07 :: A Message from the Guest Editor

# A STUDY EXAMINING THE RELATIONSHIP BETWEEN SOCIAL MEDIA USAGE AND FINANCIAL KNOWLEDGE OF WORKING WOMEN

O Prof. Amol Vaze\*O Dr. Bhaskar L. Lengure\*\*

#### Abstract:

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The primary goal of this study was to explore the relationship between financial knowledge and social media usage among employed women. To collect data, a structured questionnaire was used to survey 100 working women. Results indicated that a large portion of respondents use social media regularly and for prolonged periods, suggesting that it is a significant source of entertainment and information for many users. Moreover, social media usage may positively affect financial knowledge and decision-making confidence. The study employed linear regression analysis using Jamovi software, which demonstrated that social media usage is a significant predictor of financial knowledge. Specifically, a one-unit increase in social media usage was linked to a 0.365 unit increase in financial knowledge, holding other factors constant. The study recommends using social media platforms to promote financial literacy among working women. Lastly, the study followed ethical guidelines and principles for conducting research involving human subjects.

Keywords: Social media usage, financial knowledge & Working women

#### 1. Introduction

Social media usage has become a universal part of contemporary life, particularly for working women. It has transmuted the way people communicate, connect, and access information. Moreover, social media is increasingly being used as a platform for financial education and information sharing.

The role of social media in promoting financial literacy is important as it can expose users to financial knowledge and peer influence. Internal variables such as financial knowledge, attitude, and behavior are key components of financial literacy. However, there is a need for further investigation to identify the external variables that may influence these

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# Objectification of Women in Aravind Adiga's *The White Tiger*

## Mr. Mukesh S. Mahale

Research Scholar (English) S. G. K. College, Loni Kalbhor, Pune (M.S.)

# Dr. Sunil G. Chaudhari

Research Guide N. H. College, Brahmapuri, Chandrapur Affiliated Gondwana University Gadchiroli

#### Abstract:

The present research paper is an honest attempt to show how Aravind Adiga presents his female characters in a unique manner. A number of women characters can be identified with common Indian women whereas some of his female characters prove themselves as individual being. The present paper attempts to prove that every woman character in Adiga's *The White Tiger* willingly or unwillingly, knowingly or unknowingly accepts objectification of women. The present paper can be viewed as feminist interpretation of Adiga's *The White Tiger*.

Key Terms: Objectification, feminism and patriarchal. Introduction

It is observed that the term feminism is widely shown and heard even in the 21st century. Even the word is heading towards globalization a few people still stick up to negative approach to women. Accordingly, feminism can be studied as feminine ISM. Feminism can be defined as an attempt to create and assert identity amidst the male-centered world.

It can be studied that the present novel is a stark criticism on the society that mysteries the other gender. The author presents it through, "dark India" as per Adiga's opinion dark India is the region wherever the river of Ganga flows. The dark side represents unequal treatment given to women. For example, the protagonist of the story has to dropout from his school because he supposed to earn money to give as dowry. The girl who gives dowry represents every girl in the world of darkness whereas the protagonist here stands for every

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# The Healing Power Of Nature In Chitra Banerjee Divakaruni's "The Mistress Of Spices"

## Mr. Bhojraj Pandhari Shrirame

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#### Abstract:

This research paper explores the theme of the healing power of nature in Chitra Banerjee Divakaruni's novel, "The Mistress of Spices." The protagonist, Tilo, uses spices to heal people's physical and emotional ailments, with each spice having its own unique properties. The paper analyses how the healing power of nature is depicted in the novel and its significance. It examines Tilo's connection to nature, which is depicted as having a profound impact on her emotional well-being, and how she is able to connect with a higher power and help others find emotional and spiritual healing through her work with the spices. The paper concludes that the novel reinforces the idea that nature is an integral part of our lives and that we should strive to connect with it on a deeper level.

Keywords: Nature, Spices, Healing, Emotional, Spiritual

#### Introduction:

Chitra Banerjee Divakaruni is a highly acclaimed writer of the Indian diaspora, known for her captivating storytelling that often deals with themes of identity, belonging, and the immigrant experience. She was born in Kolkata, India, and later immigrated to the United States, where she currently resides. Divakaruni has written numerous novels, short story collections, poetry collections, and children's books. Her works have received widespread critical acclaim and have been translated into over 29 languages. Some of her notable works include The Mistress of Spices, Sister of My Heart, One Amazing Thing, and Before We Visit the Goddess. In addition to her literary career, Divakaruni is also a professor of writing at the University of Houston.

"The Mistress of Spices" is a novel that expresses the story of Tilottama, which is an Indian name that reflects her cultural heritage. However, when she moves to America, she changes her name to Tilo, her nickname, to better fit in with the culture. The name Tilottama holds significant symbolism, representing a mythological goddess of power, mysticism, and

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- Seema F. R. Sheikh Dr. G. F. Surya

- Sonal Raut Dr. G. F. Surya Dr. A.V. Khajgiwale

# A CRITICAL REVIEW OF PUBLIC AND PRIVATE SECTOR BANKS IN VIEW OF LIQUIDITY AND SOLVENCY

**O** Sonal Raut\*

O Dr. G. F. Surya \*\*

O Dr. A.V. Khajgiwale \*\*\*

#### Abstract:

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This article's goal is to examine the relationship between cash leadership and the financial performance of India's banks in both the public and private sectors. As a consequence, the performance of private sector banks and public sector financial organizations for the fiscal years 2011-12 and 2015-16 was assessed. The Cash-Deposit Ratio (CDR), Credit-Deposit Ratio (CRDR), and Investment-Deposit Ratio (IDR) were utilized to represent the liquidity position in finance, whereas Return on Assets (ROA) and Return on Equity (ROE), that were employed as substitutes, were utilized to represent organization success. It is found that CDR and IDR have a considerable negative impact on ROA. Yet, once all variables are included, independent of the type or structure of Indian business banks, there isn't an appreciable relationship between bank solvency and profitability inside the context of ROE. As a result, the banking industry could be capable of focusing on increasing their revenue at the expense of its availability, or vice versa.

#### Introduction

The tension among profitability and liquidity has long been a problem in business. The cashflow actions taken by a corporation might hypothetically have an effect on both its liquidity and profitability. Low profitability may be due to too much operating capital spending, while insufficient capital capital spending may result in inadequate liquidity. In order to gain maximum value, management must find a balance between liquidity and profitability. A company must have enough working capital regardless of whether it is profit-driven or not, as well as regardless of its size and industry. The most crucial factor in guaranteeing a bank's profitability, survival, solvency, and success is setup and maintenance

\* Research scholar, Nevjabai Hitkarini College, Bramhapuri

\*\* Principal, Renaissance Institute of Management Studies, Chandrapur \*\*\* Nevjabai Hitkarini College, Bramhapuri

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सत्राची फाउंडेशन, पटना शोध, शिक्षा एवं प्रकाशन की समाजसेवी संस्था

यह संस्था -

– साहित्यिक सम्मान देती है।

- शोध पत्रिकाएँ प्रकाशित करती है।

– पुस्तकें प्रकाशित करती है।

- सेमिनार आयोजित करती है।
- राजभाषा/राष्ट्रभाषा सेवियों को प्रोत्साहित करती है।
- गोधकर्ताओं को स्तरीय गोंध के लिए प्रोक्साहित करती है।
- नेट/जे.आर.एफ. के अभ्यर्थियों को निजुल्क मार्गदर्शन देती है।
- हिन्दी साहित्य के शिक्षार्थियों को प्रतियोगी परीक्षाओं के लिए तैयार करती है।

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# Women Uplifting The Physical Education And Sports: Growth And Development

# Dr. Kuljeet Kaur M. Sharma

Asst. College Director of Physical Education Nevjabai Hitkarani College Bramhapuri, Dist. Chandrapur M. S.

#### Abstract

Regular exercise is important for the health of both sexes. However, the physiological, anatomical, psychological and sociocultural characteristics of women require special attention in all aspects of their sport. Puberty brings with it differences between the sexes due to different sexual activity of the endocrine axis. Despite identical adaptive mechanisms to physical activity, sexually mature women and men have inherited anatomical and physiological differences in body composition, aerobic capacity and muscle strength. In particular, it refers to the more complex reproductive system of women. Puberty brings with it differences between the sexes due to different sexual activity, sexually mature women and men have inherited anatomical adaptive mechanisms to physical activity, sexually mature women. Puberty brings with it differences between the sexes due to different sexual activity of the endocrine axis. Despite identical adaptive mechanisms to physical activity, sexually mature women and men have inherited anatomical and physiological differences in body composition, aerobic capacity and muscle strength. In most societies, playing sports was primarily the domain of men. However, women's sports advocates have shown in recent decades that women are also capable and have their place in the world of sports. It is interesting to note that the positive point of view is that women who participate in sports are confident, have higher self-esteem, better leadership qualities and lead healthy lifestyles.

Keyboard: - Women, Uplifting, Physical Education, Sports: Growth, Development

#### Introduction

The purpose of this study is to help encourage more women to participate and participate not only in sport, but also in the administration, management and administration of sport. Research is also important in developing and promoting more sports programs that improve women's perceptions of sports. more positive and influence those who saw the fair participation of women in sports. The results not only increase women's awareness of the health benefits of sports, healthy lifestyles and social contributions, but also encourage them to participate. In addition, the result of this study provides empirically based information for sports organizers, administrators, coaches and trainers to provide sports programs and open

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# Study on Role and Relevance of Revival strategies of Non performing Assets in financial Management of Private and Public -sector Banks in Chandrapur District

Srinivasa Rao Mallarapu

Research Scholar, N. H. College, Bramhapuri Dr. V.V. Nagbhidkar,

Research Supervisor, N. H. College, Bramhapuri

Dr. G. Faruk S.,

Professor & Principal, R.I.M.S.

### Abstract :

Current issues of interest include the accumulation of non-performing assets, the reorganisation of corporate debt, and financing to primary and non-priority industries. Mfi has served as a game-changer for the most important lending industry, which has endured a rough history before government officials seized over banks in 1967. Nonperforming assets in the non-priority industry and restructuring of corporate debt appear to be growing sources of concern, however. While conditions were differently when BASEL II entered into effect in 2011, banks are now compelled to disclose their assets under stress, and reorganisation processes are well under way. In 2015, a record number of companies restructured their debt. The banking system has been through an acute recession characterised by a parabolic growth in assets that fail as a consequence of the adoption of monetary segment improvements & the Widesen widespread acceptance of rational bookkeeping methods in accordance with the BASEL <sup>agreement</sup>. This article analyses the growth of non-performing assets in both primary and <sup>non-price</sup> <sup>non-priority</sup> sectors and how they contribute to the overall stockpiling loans are strongly connection among NPA and different financial factors. Nonperforming loans are strongly linked to the linked to debt restructuring in businesses. There is a negative correlation between NPAs (nonperforming loans) and increased GDP.

Key-words : NPA, Commercial Banks, RBI, GDP

Introduction :

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NPAs, also known as bad loans, are financial assets that no longer generate income for ir lender (barles). their lender (banks). According to how long a debt has gone unpaid, NPAs can be divided into the state of the

three groups: Nonperforming Assets (NPAs) are assets that have been in that category for less three groups: Nonperforming Assets (NPAS) are described as nonperforming for more than a year than a year are been recognised as having suffered at than a year. Assets that have been classified user recognised as having suffered a loss, but considered to be "doubtful." These assets have been recognised as having suffered a loss, but the precise amount of this loss has yet to be determined.

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Public sector banks in India take advanced incidence for Nonperforming Assets than Public sector banks in india take as failed policy decisions, the health of the economy their private segment counterparts. Factors included policy decisions, the IBC and as a whole, and questionable lending practises. Recapitalization, the IBC, and conduct of as a whole, and questionable felding prices occupied by the authorities of India to decrease asset reviews are only some of the procedures occupied by the authorities of India to decrease the number of nonperforming assets in public sector banks. Three of the major commercial banks are the SBI, PNB, and BOB. The NPA rates charged by private sector banks in India were much lower compared to that of their public sector counterparts. They had stricter criteria for lending money and favoured clients with better credit histories, both in company and personally. Nevertheless, private sector banks also faced the challenges of managing their non-performing loan holdings. The three largest financial institutions in India are HDFC Bank, Axis Bank and ICICI Bank.

The RBI monitors the amount of bad loans held by both state-owned and commercial banks. To address nonperforming assets (NPAs) and improve the quality of banking sector assets, the RBI has dispensed procedures.

## Literature Review

Using a primary survey, Jain et al. (2015) examined precedence segment advancing for banks and proposed limits for several priority sectors.

Mishra (2016) sought to do a cursory assessment of precedence and non- precedence segments nonperforming assets through regard to public segment banks in India using subordinate sources of data.

International financial recession as well as its influence on the Indian budget was the key cause for the increase in nonperforming loans, according to research by Gupta and Kesari

According to Khosla and Kumar (2017). Indian banks have an NPA problem costing them over Rs. 90,000 crores and are losing money. It was hard to get back the terrible debts since the country's common rules were so cumbersome.

According to Sengupta and Bhardhan (2017), regulatory forbearance exacerbates the neial crisis by encouraging barlies financial crisis by encouraging banks to put off recognising nonperforming assets (NPA5) and taking corrective measures. A head, and taking corrective measures. A bank's choice to restructure a loan is a business decision and should not be rewarded with regulated to the restructure a loan is a business decision and should not be rewarded with regulated to the restructure a loan is a business decision. and should not be rewarded with regulatory breaks like delayed identification of nonperforming

# Objectives of the study

To examine the development of nonperforming assets of Indian commercial banks by bank and by industry, and to identify the advised assets of Indian commercial banks by factors. bank and by industry, and to identify the relative importance of these two factors.

 Determine whether non-performing assets are linked to corporate debt restructuring. Only secondary sources were used for this analysis. Information has been compiled from

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# CO-EDITOR'S NOTE

Date: July 20, 2023

#### Dear Readers,

It is with great pleasure and enthusiasm that I welcome you to the latest edition of the Atishay Kalit Journal. As the Co-Editor-in-Chief, I am delighted to present to you an assortment of inventive research articles, thought-provoking analyses, and innovative contributions from distinguished scholars and researchers around the country.

This issue is a demonstration of the commitment of our contributors, reviewers, and editorial board members who continually strive for excellence in advancing knowledge within their respective fields. Their dedication to rigour and integrity ensures that each publication in Atishay Kalit upholds the highest standards of academic research and knowledge.

In this volume, we are privileged to showcase an array of research papers covering diverse disciplines, addressing critical issues, and presenting fresh perspectives. The contents range from fundamental theoretical explorations to practical applications with real-world implications. It is our hope that this compilation will not only expand the boundaries of existing knowledge but also inspire future researchers, scholars and the academic community for further investigation and engagement in these areas of research.

As we continue to evolve, we are continuously refining our review processes and adopting best practices to maintain the integrity and quality of the articles we publish by plagiarism report, authors are responsible for their work with integrity. We encourage transparency and fairness in peer review, providing constructive feedback to authors to enhance their contributions and foster intellectual growth.

I would like to express my heartfelt gratitude to our esteemed reviewers who devote their time and expertise to critically assess the submissions, offering valuable insights that clevate the quality of the published work. Your dedication to maintaining the high standards of academic integrity is pivotal to the success of Atishaykalit.

Furthermore, 1 extend my appreciation to the authors for entrusting us with their research. Your efforts are shaping the future of academia and leaving a lasting impact on your respective fields.

To our readers, thank you for your continued support and interest in Atishaykalit. Your enthusiasm and engagement inspire us to strive for excellence in serving the academic community.

Finally, I invite researchers, scholars, and academics from all disciplines to submit their original research works with publication expenses to Atishay Kalit in the given timeline for Lotus and Rose issue. For more details contact <u>ritapratap52 a gmail.com</u> or +91-9314631852. By sharing your insights and discoveries with us, you contribute to the vibrant exchange of ideas and the advancement of knowledge across the globe.

Thank you for being an integral part of our academic journey. We look forward to your continued participation and support as we endeavour to make Atisliay Kalit an even more influential platform for scholarly discourse.

Wishing you an insightful and rewarding reading experience.

Sincerely, Dr. Shashi Goel Co-Editor-in-Chief, Atishay Kalit UGC Care Approved

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### NON PERFORMING ASSETS AND THEIR IMPACT ON FINANCIAL MANAGEMENT OF BANKS

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#### Abstract

Only a reliable credit evaluation and recovery management system can help you get your money back from nonperforming assets. When there is an abundance of cash and the economy is booming, banks sometimes make riskier loans, which increases the pool of nonperforming assets (NPAs) and causes anxiety about the possibility of adverse selection. When an asset becomes non-performing, the recovery team gets to work. The numerous routes for recovering nonperforming loans in the Indian banking industry are not performing to expectations. The failure of the recovery mechanism process may be attributable to factors such as improper due diligence, inadequate legislation to battle against defaulter, and externalities of macro-economic variables. From fiscal year 2003/2004 through fiscal year 2016/17, this paper examines the effect of the NPA recovery process and its three key pillars—recovery via Lok Adalat, recovery via DRTs, and recovery via SARFASEI. Only secondary information obtained from the RBI data warehouse was used to conduct the analysis. The data is analysed using SPSS version 20. The research concludes that the banking sector as a whole has a very weak mechanism for bouncing back from crises. DRT recovery is superior than the other two types of wing recoveries.

Keyword: Recovery management, Due diligence, Lok Adalat, DRTs, SARFASEI.

#### Introduction

When a leased asset, or any other kind of asset, steps generating money for the lender, it is considered non-performing. Credit facilities for which interest and/or principal payments are more than a certain number of days late are considered "non-performing assets" (NPA). The current time limit is 90 days from the loan's approval date. "A loan where the lender has some doubt is experiencing difficulties in obtaining repayments and regardless of time frame, the outcome could be a loss of capital" is a definition of a non-performing asset (NPA). In 2013, Sing and Modiyani found. A recovery mechanism is a collection of processes and standards for restoring a company's financial assets in the case of its collapse, as well as the process of developing, testing, and implementing

Non performing Assets and Their Impact on Financial Management of Banks

such procedures and standards. We all know that nonperforming assets (NPAs) do not provide revenue, need provision, raise borrowing cost, damage employee morale, and wipe out capital. In this setting, the banking sector would collapse without the successful recovery of nonperforming loans. Below, we'll go through the three main methods used in the recovery process:

#### Lok Adalat

Because to the Legal Services Authorities Act of 1987, Lok Adalat has flourished in India. Another name for it is "People's court," and former Chief Justice of India Justice P.N. Bhagwati actively supported it. The State Authority, the District Authority, the Supreme Court Legal Services Committee, the High Court Local Services Committee, or the Taluk Legal Services Committee may all hold mock courts (called Lok Adalats) as part of the Lok Adalat system, which is a non-adversarial system. The first Lok Adalat took place in Gujarat on March 14th, 1982. Banks benefit from Lok Adalat because it facilitates debt settlements through compromise between lenders and loan defaulters. Cases involving NPAs of Rs. 10 lakhs or more may now be decided by the Cok Adalat, a debt recovery tribunal. The processes seemed to be more efficient for loan collection via swift rulings on referred instances. The majority of Lok Adalat's success has come through the collection of smaller loans. To further promote the use of this process for the settlement of disputes, mobile Lok Adalats are organised in different regions of the nation. Since its commencement, more than 15.14 million Lok Adalats have been held throughout the nation as of September 30, 2015. This system has resolved more than 8.25 billion instances thus far.

#### DRTs, or Debt Recovery Tribunals

The DRT Act established the Debts collection Tribunals (DRT) and the Debts Recovery Appellate Tribunals (DRAT) for the speedy adjudication and collection of debts owed to banks and financial institutions and for issues related thereto. The Borrower/Mortgagor may seek judicial review of the Secured Creditor's action brought under the Securitization Act via DRT. For the purpose of recouping debts owed to banks and financial institutions as quickly as possible on behalf of the Government of India, Debt Recovery Tribunals were set up under Act 51 of 1993 of the Indian Parliament. Those who disagree with the outcome of actions brought by secured creditors under the SARFAESI Act 2002 may appeal to the debt recovery tribunal. Across the nation, 33 DRTs and 5 DARTs are currently active. To expedite the resolution of disputes involving loans, the government established six additional DRTs in 2014. The primary problem with DRT debt collection is the length of time it takes to resolve issues (such as settling debts and ending defaults). DRTs take a long time to resolve ongoing disputes, similar to other debt collection processes. There are about 93,000 cases waiting to be heard by DRTs around the nation as of the end of 2016. According to the World Bank, the average time it took to resolve bankruptcy in India under the former legislation was 4.3 years, which was more than twice as long as China. When compared to other economies, this is . among the poorest.

SARFAESI Act: The legislation accomplished nothing until it learned how much NPA was hurting banks' bottom lines. The recommendations of the Committee on Banking Sector reforms (Narasimham Committee Report II) and the Committee on the Restructuring of Weak Public Sector Banks (Verma Committee) led to the formation of the SARFAESI ACT in December 2002. The accelerating accumulation of Non-performing Assets at banks and financial institutions is the target

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# SBI MUTUAL FUND INVESTMENTS AND IT'S PERFORMANCE: A CRITICAL STUDY OF FINANCIAL PLANNING OF SALARIED CLASS

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### Abstract

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Mutual fund investments are made with the expectation of a positive return with little risk. The primary purpose of this research was to learn which SBI reciprocal finances investors' favour. One hundred and ten people filled out the survey that served as the study's main data source. Better returns for investors were deemed to be the primary and most important advantage of investing in SBI mutual funds, then safety and tax advantages. Most respondents favoured open-ended programmes where they may enter and leave at any time with no time limit on their investment. As a result of SBI's superior infrastructure, customer service, performance, and stratification, the vast majority of investors are pleased with the company's mutual funds. We found that an individual's college degree has very little bearing on the extent to which they comprehend mutual funds. When everything is said and done, we think the research will help the SBI mutual fund firm improve their services and policy options. Moreover, the SBI would be able to use this research to improve investor education about SBI mutual fund schemes.

Keywords : SBI mutual investment plans, customer choice, and contentment.

### Introduction

Mutual investments are pools of money from several investors who have agreed to pool their resources in order to achieve a common financial aim. A fund manager takes the money contributed by many people and invests it in securities like stocks, bonds, and shares of companies. Mutual fund investments are made with the expectation of a positive return with little risk. Therefore, the ideal asset is a mutual fund that invests. average person since they provide several advantages to their shareholders, including diversification, expert management, tax advantages, transparency, liquidity, flexibility, a wide range of investment options, low costs, etc. A major contributor to economic growth is the mutual funds sector. Capital markets become more active and local ownership of

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# IMPACT OF COVID-19 ON NIFTY CONSTITUENT INDUSTRIES WITH SPECIFIC REFERENCE TO PHARMACEUTICAL AND CONSUMER PRODUCTS INDUSTRIES

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#### Abstract

The beginning of the COVID-19 deadly disease followed by political lockdown declarations has caused instability in global business operations. A health issue has had a substantial collision on the stockpile bazaar for the first time. India's primary stock indices have lost about 40% of their value making it one of the most significant emerging facts. As a consequence, the investigator looked at how the global epidemic affected healthcare and retail businesses. For the analysis of industries belonging to these two envisaged sectors, the researcher used a modular approach with the help of three basic models in this study. The outcomes are diverse, and the industries have a recognizable influence on them. Although all industries were temporarily harmed, most of them had positive or minor effects. In specific, it has been observed that the industries belonging to pharmaceuticals and consumer products sectors have not been subjected to major brunt of COVID-19 and performed with minor effects. The present study also highlights some of the likelihood of this phenomenon.

Keywords: COVID-19, Economic Crisis, NIFTY 50, Pharmaceutical Sector, Consumer Products Sector.

### Introduction

The worldwide economy depends heavily on the system of finance. Structural crises cause extensive financial turmoil that puts the health of the economy in jeopardy and, as a result, leads to real-world shocks. Spreading individualistic unexpected events, another name for catastrophic unexpected events, cause significant crises that seriously destabilize the banking industry including the economy as a whole. As a consequence, experts and decision-makers give the banking component of a nation's economy a lot of consideration.

Authorities and company owners, especially in developing nations, are not adequately prepared to withstand significant macroeconomic or monetary instability, based on the International Monetary

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JOURNAL OF THE ASIATIC SOCIETY OF MUMBAI (A UGC - CARE Listed Journal)

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# DISENTHRALLMENT OF WOMEN IN CHITRA BANERJEE DIVAKARUNI'SSELECTED NOVELS: A REVIEW

### Mr. Bhojraj Pandhari Shrirame

Assistant Professor J. M. Patel Arts, Commerce & Science College, Bhandara Email – shri100bhoj@gmail.com **Dr. Sunil G. Chaudhari** Associate Professor N. H. College, Bramhapuri

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### Abstract:

This research paper uses the traits of Chitra Banerjee Divakaruni's protagonist to explore how women identify both within and outside the boundaries of our society. Identity describes a person's distinctiveness, values and drive toward independence. Divakaruni skillfully captures the diasporic component of identity issues in her writings. Divakaruni's books were critically examined in an effort to investigate the identities of her female protagonists. Conflict empowers people to take control of their lives and make their own decisions, but it also makes them more indifferent and pessimistic about the world around them. In Divakaruni's works, female heroes win against adversity rather than submitting to male control. As a result, the female protagonist of Divakaruni does not fit traditional expectations. They realise, there is a brave new world out there for them to explore and that they mustmake some bold decisions in order to get there because they have done the hard thinking and seen the big picture.

Keywords: women, boundaries, pessimism, tradition, adversity.

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### संशोधक

# मराठी साहित्यातील ग्रामीण कवितेचे बदलते स्वरूप

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सारांश :

मराठी साहित्यात १९६० नंतर दलित साहित्य, स्त्रीवादी साहित्य, आदिवासी साहित्य, जनवादी साहित्याबरोबरच ग्रामीण साहित्याची निर्मिती होऊन एकूण साहित्यात आमुलाग्र बदल घडून आला. शिक्षणाची गंगा खेडोपाडी पोहचायला लागल्याने नवोदीत लेखकांची पिढी निर्माण होऊन जाणिवेने लेखनाला सुरवात झाली. त्याचाच परीपाक ग्रामीण जीवन, त्यांच्या समस्या, त्यांचे हलाखीचे जीणे जगासमोर येऊ लागली. काळातील बदलानुसार बारा बलुतेदारी पद्धत संपुष्टात आली. बाजारपेठांची निर्मिती झाली. मात्र शासनाने हमी भावाची पूर्तता न केल्याने शेतकऱ्याला जीवन जगणे असहाय झाल्याने इ.स.१९८६ पासून महाराष्ट्रात शेतकऱ्यांच्या आत्महत्येला प्रारंभ झाला. हे आत्महत्येचे सत्र आजही थांबण्याचे नाव घेत नाही. अनेक ग्रामीण कवींनी आपल्या काव्यलेखनातून, काव्यवाचनातून शेतकऱ्यांच्या जगण्याला व त्यांच्या तगण्याला ग्रंथातून, विविध संमेलनातून वाचा फोडण्याचे महत्त्वपूर्ण कार्य केले. आज औद्योगिकीकरणामुळे, जागतिकीकरणाच्या प्रभावामुळे सर्व समाज ढवळून निघाला आहे. या उदारीकरणाच्या दुष्टचक्रात सापडून आपले माणूसपण हरवून बसला आहे. स्वातंत्र्यपूर्वकाळात ग्रामीण काव्याची निर्मिती झाली असली तरी त्या लेखनात निसर्गचित्रण, खेडचातील वातावरण, नातेसंबंधातील भावनिकता प्रकर्षाने अधिक आली आहे. सामान्यांच्या जगण्याला अधिक जोरकसपणे वाचा फोडण्याचे काम स्वातंत्र्योत्तर काळात अधिक झाल्याचे जाणवते. एकविसाव्या शतकात कास्तकार वर्गात हक्कांची पूर्णता जाण निर्माण होऊन तो संघर्षासाठी उठून पेटला आहे. आजच्या शेतकऱ्यांच्या विविध संघटना, हक्कासाठी संप, मोर्चे याचेच द्योतक आहे. प्रस्तुत संशोधन लेखात कालखंडानुसार ग्रामीण कवीचे, त्यांच्या महत्त्वपूर्ण काव्याचे संदर्भ देऊन या सर्व बाबीचे विस्तृत विवेचन येथे केले आहे.

### प्रस्तावना :

भारत ग्रामवासीयांचाच देश समजला जातो. विसाव्या शतकाच्या उत्तरार्धापर्यंत भारतातील जवळपास ७० टक्के लोक ग्रामीण क्षेत्रात रहिवास करून शेती या व्यवसायावर उपजीविका करत होती, मात्र आज औद्योगिकीकरणामुळे ग्रामीण भागातील लोकांचा लोंढा शहरांकडे वळताना दिसत आहे. असे असले तरी व्यक्तिमनातील ग्रामीण जीवनाबद्दलची संवेदनशीलता कमी झालेली जाणवत नाही. ग्रामीणता ही भारतीय जीवन पद्धतीचा अविभाज्य अंग आहे. साहित्य जगतामध्ये ग्रामीणतेवर अनेक प्रकारचे लेख, कथा, काव्यनिर्मिती केल्या गेली आहे. सामान्यपणे ज्या कवितेमध्ये ग्रामीण जीवन, तेथील परंपरा, सण, उत्सव यांचे चित्रण ग्रामीण संवेदनेने प्रकट झालेले असते. तिला 'ग्रामीण कविता' असे म्हणतात. हया कवितांमध्ये खेडे, खेड्यांशी संबधीत असलेले कृषीजीवन, तेथील लोकांचे दु:ख, आनंद, गरिबी, रूढी, परंपरा, संस्कृती या सर्व गोटींचा समावेश केलेला असतो.

ग्रामीण कविता म्हणजे गावातील सामान्य जनजीवनाचा व दैनंदिन अनुभवाचा एक पाढाच होय. ग्रामीण कवितेमध्ये गाव, तेथील पारंपरीक मूल्ये व निसर्ग यातून उभे राहिलेले ग्रामजीवन असते. कवितेच्या निर्मितीच्या तळाशी असलेली संवेदनशीलता ही ग्रामीण जीवनाचे चित्रण अधिक सूक्ष्मतेने घडवित असते, न्याय देण्याचा प्रयत्न करीत असते, अशी कविता ग्रामीण आहे, असे आपणास म्हणता येईल. बीजशब्द :

ग्रामीण जीवन, निसर्ग, प्रादेशिक, दारिद्रच, कृषीजीवन इत्यादी.

## विषयविवेचन :-

ग्रामीण कवितांचा शोध किंवा विकास घडवून आणण्यास अनेक तळागाळातल्या ग्रामीण कवींचे योगदान आहे. ग्रामीण कवितामध्ये खेडेगाव, तेथील जीवनपद्धती, तेथील रीतीरिवाज, शेतीव्यवसाय, निसर्ग, मातीशी असलेला

पुरवणी अंक-१५. डिसेंबर २०२३