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Abstract. In the present report a sequence of Eu3+ (1-9 mol%) incorporated Mg2SiO2 nanopowders (NPs) are prepared through green mediated Sonochemical synthesis by means of Aloe vera gel as surfactant. Powder X-ray diffraction (PXRD) patterns are studied in order to authorize the phase transparency of the fabricated samples. The PXRD profiles displayed that the fabricated samples have orthorhombic phase [JCPDS Card No. 78-1371] with a space group Pb nm–62, with no change in the diffraction profiles due to the addition of the Eu3+ ions. The photometric diagrams demonstrate wide excitation and a few sharp peaks. The sharp tops at 360, 375, 381, 393 and 413/362, 373, 381, 450 and 464 nm were 7F0 → 5H6, 7D4, 5L7, 5L6 and 5D3 f-f transitions of Eu3+ particles individually. The emission diagram comprise sharp and exceptional peaks situated at ~ 590, 612, 652 and 700 nm and was because of the 5D0 → 7FJ (J= 1, 2, 3, 4) advances of 4F6 setup of Eu3+ particles, separately. The CIE arranges (x, y) are resolved (x = 0.55, y = 0.43) for Mg2SiO4:Eu3+ (5 mol %) relate red emanation which are practically close of the Standard qualities (x = 0.67, y = 0.33), the Correlated Color Temperature (CCT) was obtained 1992K. We successfully demonstrate the synthesized nanophosphor engaged as a labeling agent to enhance LFPs on different infiltrate and non-infiltrating surfaces. These results indicated that the prepared NPs can be effectively employed in the field of wLEDs and latent finger print detection.

INTRODUCTION

As of now, among different silicate families, Forsterite (MgSiO3) have display extraordinary properties, for example, low warm development, stable crystal structures, great dissolvability and eco-friendly [1]. Further, it has wide scope of uses in refractory industries, strong oxide energy components, as an encasing at high frequencies, utilized in microwave coordinated circuits and luminescent innovation. Rare-Earth(RE) doped Mg2SiO4 nanomaterials were utilized in the fields of optoelectronic devices and medicinal fields [2].

Among the available techniques, ultra-sonication is investigated as non-ordinary, economic, eco-friendly and utilization of formats to get wanted utilitarian surface alterations is very simple from this strategy [3]. In the present investigation, Mg2SiO4:Eu3+ (1-9 mol %) luminescent material powder was fabricated using AV. gel. By adjusting different experimental conditions, morphology of the prepared nanophosphors was tuned. The photometric investigations of the ultrasound helped Mg2SiO4:Eu3+ displayed that it may be potential red component for white LED applications.

In the recent times, latent fingerprints (LFPs) have been used as an authoritative proof to recognize an individual’s information. FPs have been commonly considered to be an effective tool in the crime scene. It has unique features such as, type 1 (ridge flow), type 2 (core, delta, and bifurcation) and type 3 (sweat pores) that are the characteristic in each person identification. Furthermore, LFPs are undistinguishable to the bare eye at crime spot and it is very difficult to identify the criminal. Hence, there is an urgent need of more accurate visualization technique. Till date, there are many reports for identification and development of the fingerprints, such as, Ninhydrin, fluorescent dyes, multi-metal.
deposition (MMD), powder dusting etc. [4]. Among them, powder dusting method is the effective technique for the visualization LEPs on different materials surfaces. Different types of materials such as semiconductor quantum dots, magnetic nanoparticles specifically Au nanoparticles and inorganic nanoparticles are used to visualize the LFPs are reported [5]. However, some technical faults namely, fabricated measures, harmfulness, damaging character of visual photographs and conservation time usually delayed their extensive features. Hence, there is tranquil an instant requirement for quick, exact, effective and non-destructive material for rich visualization of LFPs.

MATERIALS AND METHOD

In this work, Magnesium Nitrate Mg(NO$_3$)$_2$, Tetra Ethyl Ortho-Silicate (TEOS) and Europium Nitrate Eu(NO$_3$)$_3$ were utilized them as acquired. A.V. gel as surfactant extricated straightly from the inside area of the A.V. leaves which were altogether trampled and pounded into slender gel structure [6].

RESULT AND DISCUSSION

FIGURE 1. (a) Powder X-ray beam diffraction diagrams and (b) William-Hall charts of Mg$_2$SiO$_4$: Eu$^{3+}$ (1–9 mol %) nanophosphor.

FIGURE 1 (a) shows diffraction diagrams of ultrasound assisted Mg$_2$SiO$_4$: Eu$^{3+}$ (1-9 mol %) samples. In the powder X-beam diffraction, perception profiles are fine coordinated to orthorhombic stage [JCPDS Card No. 78-1371] with a space bunch Pb nm - 62. No hints of extra peaks comparing to Eu$^{3+}$ were identified [7]. Further, it was plainly apparent that, as nearness of Eu dopant raises, diffraction bends are marginally moves into littler edge side. Because of substitution of bigger dopant Eu$^{3+}$ particles in the cross sections Mg$^{2+}$ particles prompt line expanding and peak moving. The mean of the crystallite size (D) and strain of the created tests were determined qualities was observed to be 17-23nm from both Scherrer's equation and W-H techniques.
FIGURE 2. SEM images of Mg$_2$SiO$_4$: Eu$^{3+}$ (5 mol %) nanophosphor with different sonication times (1, 2, 3, 4, 5 and 6 h).

Fig. 2. The SEM image obtained for 1 h sonication exhibits extremely dense irregular shaped nanoparticles. Irregular shaped nanoparticles slightly modified into aggregated small nano-plates in the form of aggregated nano-buds were noticed for 2 h sonication time. When the sonication time was increased to 3 h, these nano plates were slightly grow and separated. As the sonication time reaches 4 h, the hexagonal shaped petals present in nano-buds with unusual shape (inset of Fig.). When increase of reaction time from ~ 5 to 6 h, the hexagonal shaped petals grow into larger ones and undergo self-assembly to form flower-like morphology.

FIGURE 3. Photometric diagrams of Mg$_2$SiO$_4$: Eu$^{3+}$ (1-9 mol %) NP. (a) Absorption spectrum (b) Emission Spectra.

The photometric diagrams of Mg$_2$SiO$_4$: Eu$^{3+}$ (5 mol %) test observed at $\lambda_{emi}$ = 612 nm was shown in Fig.3(a). It demonstrates wide excitation and a few sharp peaks. The sharp peaks at 360, 375, 381, 393 and 413/362, 373, 381, 450 and 464 nm were because of $^7F_0 \rightarrow ^5H_{6,7}, ^5L_6, ^5L_7$ and $^3D_1$ f-f transitions of Eu$^{3+}$ particles individually [8]. Fig.3(b) shows the emission spectrum, this diagram comprise sharp and exceptional peaks situated at ~ 590, 612, 652 and 700 nm and was because of the $^5D_0 \rightarrow ^7F_{J}$ ($J$ = 1, 2, 3, 4) transitions of $^4F_6$ energy levels Eu$^{3+}$ ions, separately [9]. The crest at 612 nm ($^5D_0 \rightarrow ^7F_{2}$) was because of electric – dipole (ED)moment and was much extreme and progressively delicate the host matrix. The small emission peak at 590 nm ($^5D_0 \rightarrow ^7F_{1}$) was because of magnetic dipole (MD) moment which was not sensitive to host matrix [10].
FIGURE 4. CIE graph of Mg$_2$SiO$_4$: Eu$^{3+}$ (1-9 mol %) NP

The CIE arranges (x, y) are resolved (x = 0.55, y = 0.43) for Mg$_2$SiO$_4$:Eu$^{3+}$ (5 mol %) relate red emission which are practically close of the Standard qualities (x = 0.67, y = 0.33) [11]. Fig.4 shows the Correlated Color Temperature (CCT), It was found to be 1992K (<500K warm light source and >5000K cool light source) for Mg$_2$SiO$_4$: Eu$^{3+}$ (1-9 mol %) nanophosphor [12].

Revelation of LFPs using Mg$_2$SiO$_4$:Eu$^{3+}$ (5 mol %) nanophosphors under UV 254 nm

FIGURE 5 Comparison of the LFPs stained by (a) Mg$_2$SiO$_4$: Eu$^{3+}$ (5 mol %) nanophosphor (left) and (b) TiO$_2$ powder (right). Some minutia ridges of the fingerprint were identified and images were shown (left).

To know the applicability of the synthesized Mg$_2$SiO$_4$:Eu$^{3+}$ (5 mol %) nanophosphor, traditional labeling powder was used as control. The LFPs stained by Mg$_2$SiO$_4$: Eu$^{3+}$ (5 mol %) nanophosphor and commercial magnetic powder on a glass slide under 254 nm UV light were shown Fig.5. From the figure, it was confirmed that fingerprint ridges were not clearly identify the minutiae ridges in the fingerprints stained by conventional powder. However, the synthesized product was noticeably enhanced minutiae ridges effortlessly due to their smaller crystalline size (Fig.5 (left)). Hence, it was
confirmed that, preparation of nanophosphor was quite useful in order to enhance LFPs in different porous and non-porous materials [11].

When LFP’s deposited on surfaces, 99 % of the constituents were quickly evaporate while only few constituents were left. The left constituents including inorganic and organic constituents such as sodium chloride, potassium chloride and amino acids, fatty acids, proteins respectively [12]. The luminescent Mg2SiO4:Eu3+ (5 mol %) nanophosphor stained on LFPs would react with chemical constituents present in residue of LFPs. Due to smaller particle size of Mg2SiO4:Eu3+ (5 mol %) nanophosphor and convenient and inexpensive instrumentation rendered that prepared sample and followed method was ideal for enhancement of LFPs on various porous and non-porous surfaces.

![Image of LFPs under UV 254 nm enhanced by Mg2SiO4:Eu3+ (5 mol %) nanophosphor on different surfaces.](image)

**FIGURE 6.** LFPs under UV 254 nm enhanced by Mg2SiO4:Eu3+ (5 mol %) nanophosphor on: (a) glass, (b) stainless steel sheet, (c) aluminum foils (d) mobile screen, (e) & (f) textured marbles and (g) & (h) color paper.

Normally, the enhancement of fingerprints on infiltrating materials was practically challenged due to rapid absorption of the chemical constituents of fingerprints by these materials. To evaluate the versatility of the prepared sample, LFPs were enhanced on different infiltrating materials namely papers with dissimilar background colors (Fig.6 (g & h)). Interestingly, the clearer ridge patterns observed without any background interference.

We successfully demonstrate the synthesized Mg2SiO4:Eu3+ (5 mol %) nanophosphor engaged as a labeling agent to enhance LFPs on different infiltrate and non-infiltrating surfaces. The Mg2SiO4:Eu3+ (5 mol %) nanophosphor stained LFPs shows patterns with high efficiency (because procedure involves simple setup and fast and performed within 5 min) and high sensitivity (because no color hindrance and chemical constituents can be observed due to smaller crystalline size). In addition, Mg2SiO4:Eu3+ (5 mol %) nanophosphor can be stored for longer time without any loss of luminescence efficiency.

**CONCLUSION**

In conclusion, Mg2SiO4: Eu3+ (1-9 mol %) NPs prepared using AV gel surfactant by ultrasonication technique. The surface structures of the samples had different morphology for various surfactant concentration and sonication time. The PL spectra display extraordinary peaks at ~ 590, 612, 652 and 703 nm. We are intrigued by the Mg2SiO4: Eu3+ (5 mol %) NPs because of their minimal effort, nontoxicity, nano routine, and simplicity to utilize. In addition, the applicability of the NPs is investigated in the latent fingerprint detection. The obtained outcomes specify that the powders can be
efficiently used in detecting the LFPs with all the three ridge features. In one sentence the green mediated prepared NPs can be effectively utilized in the field of display device and advanced forensic applications.

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