Title:	Lanthanide Ions doped bismuth based nanomaterials: structural, photoluminescent properties and applications
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Abstract:	Lanthanide ions doped nanomaterials are an important class of luminescent materials and are widely used in various field such as, display devices, lasers, solar cells, fluorescent probes for biological labeling, imaging and therapy, catalysis, nano-electronics, latent fingerprint development and anti-counterfeiting, etc. In most of the cases, host material is based on rare earth elements which are very expensive and obtaining in large quantities with high purity is very difficult. In the present thesis, we are concentrating on the Bi3+ based host materials which have similar properties to rare earths and less expensive, non-toxic. In addition, bismuth shows characteristic emission which is very much useful in applications like ant-counterfeiting. NaBi(MoO4)2 nanomaterials are synthesized through a facile, low cost coprecipitation method at room temperature. Various factors affecting the synthesis process have been investigated. Further, linear solid solution formation between NaBi(MoO4)2 and NaEu(MoO4)2, NaLa(MoO4)2 has been observed in the complete range of composition. Their structural, optical properties are studied. Photoluminescence properties of Eu3+ doped solid solutions are investigated in detail. The effect of the bandgap on the Eu3+ luminescence properties have been investigated in a systematic way and it plays a crucial role particularly when excited with high energy light. However, it does not make much difference when excited with low energy light. Excitation dependent downshifting and upconversion luminescence properties of NaBi(MoO4)2: Yb3+, Ln3+ (Ln = Er, Ho) nanomaterials are studied under UV, Visible and NIR excitation. Finally, crystal structure of Gd0.95Eu0.05PO4 nanorods is tuned from hexagonal to monoclinic by varying synthesis temperature and used in latent fingerprint detection and anti-counterfeiting applications. The developed latent fingerprints with monoclinic nanorods emits fuchsia color and shows clear ridge details and have high contrast, high sensitivity, and high selectivity. The printed patterns with GdPO4:Eu3+ fluorescent ink appeared white and emits fuchsia color under day light and 395 nm UV irradiation. Further, the effect of bismuth doping on the structural, optical, and luminescent properties of Gd0.95Eu0.05PO4 are studied. The best luminescence is observed with Bi0.50Gd0.45Eu0.05PO4 nanomaterial and utilized in anti-counterfeiting applications. The printed patterns emit orange-red, yellow-green, and fuchsia color under 254, 365, and 395 nm UV irradiation. These patterns are highly resistant to humidity, heat, and light. These nanomaterials may be used in high-tech security patterns against counterfeiting.
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