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Green emitting $CaMoO_4$:Tb^{3+} nanoparticles as luminescent probe for selective sensing of Fe^{3+}/Fe^{2+} ions

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Abstract

Polyvinylpyrrolidone (PVP) functionalized Tb^{3+} activated $CaMoO_4$ nanoparticles (NPs) were prepared through hydrothermal synthesis method. The structure and morphology of the tetragonal phase $CaMoO_4$ nanoparticles were characterized using XRD and TEM respectively. The surface functionalization and formation of the sample was confirmed from the FT-IR spectroscopy. The photoluminescence (PL) studies show the presence of broad absorption peak ∼275 nm corresponds to the MoO_4^{2-}. An intense green emission of Tb^{3+} at 544 nm was observed. This is due to efficient energy transfer from host to the activator i.e. from the molybdate absorption to the excited states of Tb^{3+}. Out of various metal ions, the nanoparticles show selective detection of Fe^{3+} ions in the whole pH range with a limit of detection of ∼6 μM. Also, these nanoparticles detect Fe^{2+} ions in alkaline media. This is due to PL quenching of the NPs in the presence of Fe^{3+}/Fe^{2+} ions. Both dynamic and static quenching are responsible for PL quenching process. The PL decay lifetime also supports the nature of quenching mechanism. These NPs could be a potential candidate for sensing of Fe^{3+}/Fe^{2+} ions in aqueous media.

Keywords: Hydrothermal, Nanoparticles, Photoluminescence, Quenching, Decay lifetime, Sensing

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