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Entitled

LANTHANIDES IN MIXED METAL OXIDES TO METAL-ORGANIC FRAMEWORKS: SYNTHESIS, CHARACTERIZATION, AND PHOTOCATALYTIC PERFORMANCE

by

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Abstract

Known as rare-earth elements (REE), lanthanides (Ln) found in f-blocks of the periodic table, have gained much interest because of their unique characteristics including magnetism, photoluminescence and catalysis. Having a diverse range of coordination geometries, lanthanides can result in different complexes and materials. Herein, three classes of materials containing selected lanthanides such as lanthanide bismuth mixed metal oxides (Ln-Bi oxides), 1D lanthanide coordination polymers (Ln-CPs) and lanthanide metal-organic frameworks (Ln-MOFs) were investigated. Simple route sol-gel method was used to prepare Ln-Bi oxides while Ln-CPs and MOFs were prepared by hydrothermal condition. The materials were characterized using multiple analytical, spectroscopic and computational techniques to study their chemical and physical properties. Based on their band gap values, Ln-Bi oxides and Ln-CPs showed great potentials for photocatalysis in the visible and UV regions respectively. Ln-MOFs in the other hand, exhibited unique photoluminescence properties with efficient quantum yields and long lifetime decays. Density functional theory (DFT) was employed and revealed a new mode of luminescence in these materials which is explored for the first time. The magnetism behaviour of Ln-MOFs and Ln-CPs was also studied by DFT that was found to agree with the experimental outcomes. The results presented here pave the way for distinct construction of materials with lanthanides as an advantage for inspecting more unique properties and applications.

Keywords: lanthanides, bismuth, mixed metal oxides, coordination polymers, metal-organic frameworks, magnetism, photoluminescence, photocatalysis, band gap, quantum yield, time-resolved photoluminescence, density functional theory.