Synthesis, characterization, luminescence, and photocatalytic properties of undoped and rare earths doped Bi_2O_3

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Several pollutants have been detected in natural aquatic bodies, including surface and groundwater, sewage water and drinking water due to their solubility in water and their chemically stability. As a result of the occurrence of these undesirable waste products in natural water bodies, humans are faced with the most pressing problem of the removal of environmental pollution to ensure safe drinking water and healthy aquatic ecosystems. The manufacture and extensive use of textile industry dyes and their intended and unintended discharge into the environment raises concern because of their risks to human health. Thus, with the urgent need of the undeniable requirement for pure drinking water worldwide, advanced methods for environmental remediation of dye contaminated water are highly required. Photocatalysis, an advanced oxidation process, has emerged as one of the broadly accepted and effective techniques for the complete mineralization of organic dyes in aqueous media. Also, photocatalysis was found to be a clean, safe, economically efficient and environmentally friendly technique. In addition, Bi_2O_3 shows weak luminescence properties on its own that restrict its application as a light emitting phosphor. Therefore, many researchers to focused on improving the weak luminescence of Bi_2O_3 in the visible region by the introduction of lanthanides into the Bi_2O_3.

The present work aimed to synthesize undoped α-Bi_2O_3 and α-Bi_2O_3:RE^{3+} (RE^{3+}= Eu, Ho, Sm) by citrate sol-gel and co-precipitation methods. The study also aimed to investigate the influence that the RE inclusion into the Bi^{3+} sites in the Bi_2O_3 crystal have on the physical and chemical properties of the newly isolated products. The study concentrated on the structural, morphological, optical, and photocatalytic influence of the lanthanides (Eu, Ho, and Sm) modified Bi_2O_3 structure as a function of RE^{3+} doping concentration. In addition, the study targeted the photocatalytic removal of organic dyes from pollutant water under UV-visible light and on enhancing the weak emission of Bi_2O_3 in the visible region by the doping of REs ions into the Bi_2O_3 matrix.

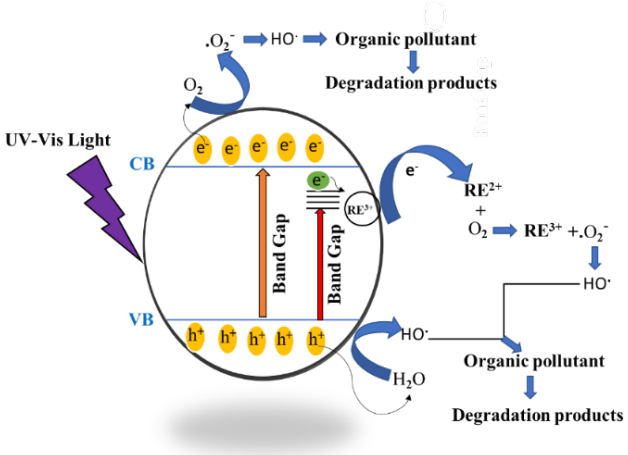

Fig.1. Schematic diagram showing the possible photocatalytic mechanism of α-Bi_2O_3:RE^{3+} towards dye degradation.