

Evaluation on the optical properties of Ga₂O₃-x thin films co-doped with Tb³⁺ and transition metals (Mn²⁺, Cr³⁺) prepared by a photochemical route

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Abstract

Gallium β -diketonate complexes were studied as precursors for the photochemical deposition of amorphous thin films of gallium oxide doped with terbium and co-doped with chromium or manganese. Solutions of the inorganic complexes were spin coated on Si(100) and quartz substrates and photolyzed at room temperature using 254 nm UV light. The photolysis of these films induces the fragmentation of the complexes and the partial reduction of the metal ion together with the release of volatile organic compounds as sub-products. When the metallic complexes are irradiated under air, the products of the reactions are metal oxide thin films. The photochemical reactivity of these films was monitored by UV-vis spectroscopy, followed by a post-annealing treatment. The obtained films were characterized by X-ray photoelectron spectroscopy and X-ray diffraction. The optical properties of the films showed that these are highly transparent in the visible spectrum but decrease significantly in doped and co-doped films. Under UV light excitation (254 nm) the doped films (Ga₂O₃-x/Tb) show the characteristic emissions at 486, 530, 542 and 610 nm associated to 5D₄→7F_J (J=6,5,4,3) transitions of Tb³⁺ ion. However, these emissions decrease and deteriorate in the co-doped films (Ga₂O₃-x/Tb/M, where M=Mn or Cr). A possible emission mechanism and energy transfer have been proposed..

Keywords

Photochemical deposition, Thin films, Optical materials, Luminescent materials.