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Optical and Structural Properties of Europium Oxide Thin Films on Silicon Substrates

Gabriele Bellocchi, G. Franzò, F. Iacona, S. Boninelli, M. Miritello, A. Terrasi, C. Spinella, and F. Priolo

Abstract Europium-based materials are known for their intense and stable emission in the visible region. Moreover Eu is stable in both its divalent and trivalent oxidation states. In particular, emission of Eu^{2+} is much stronger, being allowed for electric dipole transition rules and is characterized by a broad peak, centered in the wavelength range 400–600 nm, while that of Eu^{3+} presents several sharp lines at around 600 nm. These peculiar optical properties make Eu-based systems an interesting material for photonic applications. The optical and structural properties of Eu_2O_3 thin films grown by RF magnetron sputtering on Si substrates have been studied. PL emission has been observed at room temperature and it is strongly dependent on the thermal process. In particular, annealing in O_2 atmosphere leads to an enhancement of the Eu^{3+} emission, while films annealed in N_2 ambient exhibit a very intense PL signal due to Eu^{2+}. The chemical and structural characterization of the films, performed by TEM and XPS, reveals that a massive mixing at the Eu_2O_3-Si interface occurs in N_2-annealed samples, leading to the formation of Eu (II) silicates, while in the case of O_2-annealed samples we observe the formation of a SiO_x layer at the interface, that minimize the diffusion of Si into the Eu_2O_3 layer.

G. Bellocchi • G. Franzò • F. Iacona • S. Boninelli • M. Miritello • A. Terrasi • F. Priolo
MATIS CNR IMM, via Santa Sofia 64, Catania, 95121 Italy

G. Bellocchi (✉) • A. Terrasi
Dipartimento di Fisica e Astronomia, Università di Catania,
via Santa Sofia 64, Catania 95121, Italy
e-mail: gabriele.bellocchi@ct.infn.it

C. Spinella
CNR IMM, Sezione di Catania, Stradale Primosole 50, Catania 95121, Italy

G. Bellocchi
Department of Physics and Astronomy, MATIS, IMM-CNR & University of Catania,
via S. Sofia, 64, I-95123 Catania, Italy
e-mail: gabriele.bellocchi@ct.infn.it

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