PA-MBE Grown CdMgO:Eu Ternary Alloy on m- and c-Oriented Al_2O_3 Substrates

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Oxides based on cadmium (Cd) and magnesium (Mg) due to their properties can find an extensive range of potential applications in photovoltaics, light-emitting diodes, and other optoelectronic devices. In this work, a series of CdMgO:Eu ternary alloys were grown on *m*- and *c*-oriented Al_2O_3 with varying Mg concentrations using plasma-assisted molecular beam epitaxy. The crystal structure and topographical features of grown ternary alloys were analyzed using X-ray diffraction and atomic force microscopy (AFM). X-ray photoelectron spectroscopy (XPS) was used to determine the chemical state and composition of Eu and it confirmed Eu^{3+} europium oxidation states. The optical properties of as-grown and annealed samples were examined with UV-visible spectrometry, PL, and CL measurements. Transmission spectra revealed that the alloys are highly transparent in the visible region, where transmittance increases with incident wavelength (**λ**) and over 500 nm approaches nearly 90% for all samples **Fig. 1. (a-b).** Utilizing diffuse reflectance spectra, the dielectric constants, refractive index, and extension coefficient were also evaluated. The band gap energy (E_g) was estimated using the standard Tauc plot and the Kubellka-Munk model. The increasing trend was observed in (E_g) under Mg-rich conditions. From transmittance spectra, the highest energy gap values for *m*- and *c*-oriented alloys are estimated to be 2.866 eV and 3.011 eV, which are due to the high Mg concentration as consistent with literature [1]. CL confirmed the presence of Eu-related peaks in the red spectral range for annealed samples. The surface topography of CdMgO:Eu alloys are homogeneous and uniform; rms values are at the level below 1 nm and increase with Mg concentration.

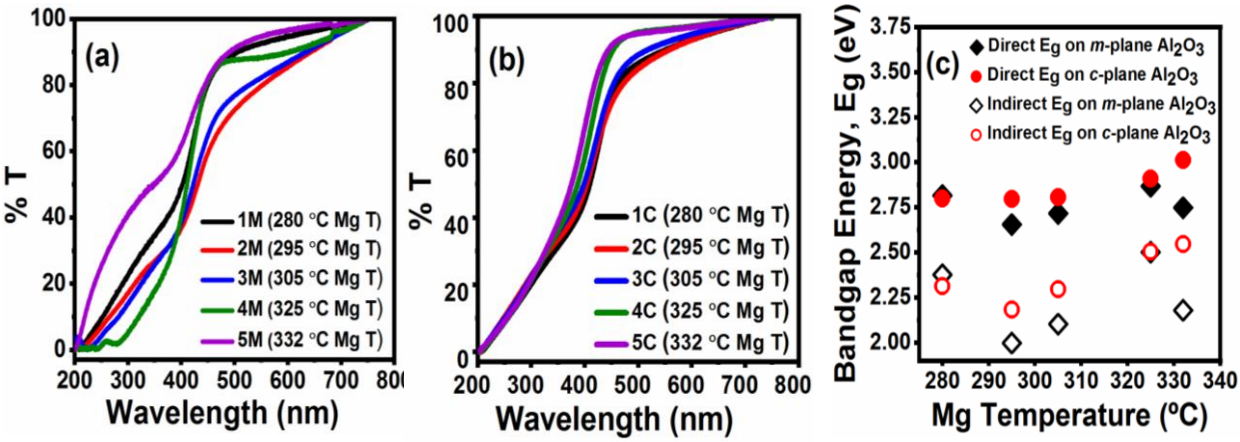

Fig. 1. (a-b) Transmittance vs **λ** for *m*- (1M-5M) and *c*-oriented (1C-5C) alloys samples, **(c)** Direct and indirect bandgap energy (E_g) of CdMgO:Eu alloys on *m*- and *c*-oriented Al_2O_3 from transmittance spectra.

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[1] A. Adhikari, A. Lysak, A. Wierzbicka, P. Sybilski, A. Reszka, B.S. Witkowski, & E. Przezdziecka, *Materials Science in Semiconductor Processing*. *144*, 106608 (2022).