Optimization of in situ Eu-doped Cd(Zn)O/Zn(Mg)O SLs structures growth by MBE to obtain efficient europium emission

[1]A. Lysak, [1]A. Wierzbicka, [2]S. Magalhaes, [1]P. Dłużewski, [1]R. Jakieła, [1]Z. Khosravizadeh, [1]A. Adhikari, [1]A. Kozanecki, [1]E. Przeździecka

[1]Institute of Physics, Polish Academy of Sciences, Warsaw, Poland

[2]IPFN, Instituto Superior Técnico, Universidade de Lisboa, Portugal

corresponding author: wierzbicka@ifpan.edu.pl

Optimization of in situ Eu-doped Cd(Zn)O/Zn(Mg)O SLs structures growth by MBE to obtain efficient europium emission In recent years, wide-bandgap semiconductors doped with rare earth (RE) elements have received significant attention for their potential in optoelectronic devices. ZnO is a promising candidate for RE doping due to its unique properties. In addition, the band gap energy of ZnO can be modulated from visible to deep UV region by creating ternary solid alloys (ZnCdO, ZnMgO, etc.). Although the properties of RE-doped ZnO are well studied, information about ZnCdO and ZnMgO ternary alloys doped with RE ions remains limited.

In this work, we study in situ Eu-doped Cd(Zn)O/Zn(Mg)O short-period superlattices (SLs) with various sublayer thicknesses deposited on m-plane sapphire substrates (Al2O3) using PA-MBE. This technology provides precise control of the thicknesses and composition of sublayers, which is critical for growing quantum structures. MBE allows the incorporation of RE ions into the quantum structures without damaging the crystal lattice, a common issue with RE implantation methods.

Structural and optical properties of the Eu-doped Cd(Zn)O/Zn(Mg)O SLs were investigated using various techniques, including TEM, XRD, UV-Vis spectroscopy, SIMS, and CL. Obtained results confirmed high-quality superlattices, with characteristic in XRD analysis satellite peaks indicating good periodic structures. CL measurements showed near-band-edge (NBE) and deep-level (DLE) emissions, as well as Eu related emissions. Additionally, the effect of Mg incorporation into ZnO barriers and influence of the post-grown annealing temperature on the Eu related red emission intensity were studied. The results of studying the properties of in situ Eu-doped Cd(Zn)O/Zn(Mg)O SLs demonstrated the potential of

these structures in future optoelectronic applications.