

# Emission from the axial heterostructure on ZnO microrod observed by cathodoluminescence

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Optical properties of individual ZnO microrods (MRs) grown by hydrothermal method with axial  $\text{Zn}_{1-x}\text{Mg}_x\text{O}/\text{ZnO}/\text{Zn}_{1-x}\text{Mg}_x\text{O}$  heterostructure grown (on top of the ZnO microrod) by plasma-assisted molecular beam epitaxy have been studied by spatially resolved cathodoluminescence (CL) spectroscopy and imaging. The CL spectroscopy has been combined with other techniques: X-ray diffraction and transmission electron microscopy, in order to get insight into the lattice parameters and local stress in ZnO-based heterostructures.

The CL depth profiling (as a function of the electron beam energy – accelerating voltage (AV)) has provided the data for analysis of the behavior of excitonic emission from ZnO MR, ZnO buffer, a single quantum well (QW) and  $\text{Zn}_{1-x}\text{Mg}_x\text{O}$  barriers. The spectrum measured at AV=4 kV (Fig. 1a) contains a sharp peak located at 3.38 eV. It is related to recombination of excitons in the 4 nm ZnO single QW. The line at 3.35 eV is assigned to donor-bound excitons (DX) emission in ZnO MR. At the high-energy part of the spectrum a peak with maximum at 3.60 eV occurs, which originates from recombination in  $\text{Zn}_{1-x}\text{Mg}_x\text{O}$  barrier. CL emission energy enables us to determine the Mg concentration  $x$  in the  $\text{Zn}_{1-x}\text{Mg}_x\text{O}$  barrier as  $x=0.16$ .

We have also performed cross-sectional mapping of CL. An example of the results obtained by this method is shown in Fig. 1b. It clearly indicates the difference between CL emission from the ZnO MR, ZnO QW and  $\text{Zn}_{0.84}\text{Mg}_{0.16}\text{O}$  barriers.

Our studies clearly confirmed the presence of axial heterostructure grown on ZnO MRs and enabled determination of its basic parameters: QW thickness and Mg concentration in the barrier from the CL transition energy.

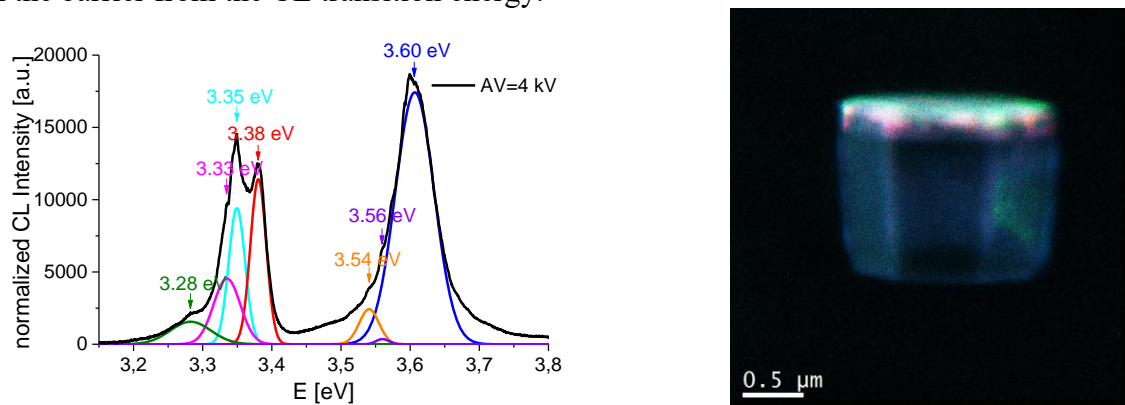


Fig. 1. a) CL spectrum taken at AV=4 kV, b) False colour CL image of ZnO MR with axial heterostructure: 3.60 eV – green, 3.38 eV – red, 3.35 eV – blue.