Characterization of Luminescence of thick MgZnO Layers and MgZnO/ZnO Quantum Wells

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The wide gap material ZnO (Eg= 3.3eV at 300K) is a promising candidate for optical applications such as LEDs or laser diodes. A mixture of ZnO and MgO (Eg ~ 7.6eV) allows an expansion to wider band gap into the far UV spectral range.

A direct correlation of structural and optical properties of thick MgZnO-layers and MgZnO/ZnO quantum well structures has been achieved on a microscopic scale using highly spatially and spectrally resolved cathodoluminescence (CL). A series of MOCVD grown MgZnO epitaxial layers (1µm thick) with increasing Mg incorporation on ZnO/sapphire substrate were investigated. No remarkable change of the morphology is found with increasing Mg-content. The laterally integrated CL spectrum of each sample is dominated by three spectral bands. Two bands at higher energies can be assigned to the MgZnO emission, e.g. for a sample with [Mg] = 6% we find at 5K E_1= 3.474eV and E_2= 3.442eV, respectively. These two peaks strongly correlate with the micro-morphology of the samples and shift simultaneously to higher energies with increasing Mg-content. The ZnO emission peak energy (E= 3.356eV) remains constant, indicating no additional stress. A detailed analysis of the recombination and relaxation kinetics measured by time resolved and excitation density and temperature dependent CL will be presented.

In the MgZnO/ZnO quantum structures two additional lines appear in the spectra originating from the 2nm thick single quantum well. Surface features of the layers clearly correlate with the local CL emission characteristic. A detailed analysis of luminescence is given (see Fig. 1).

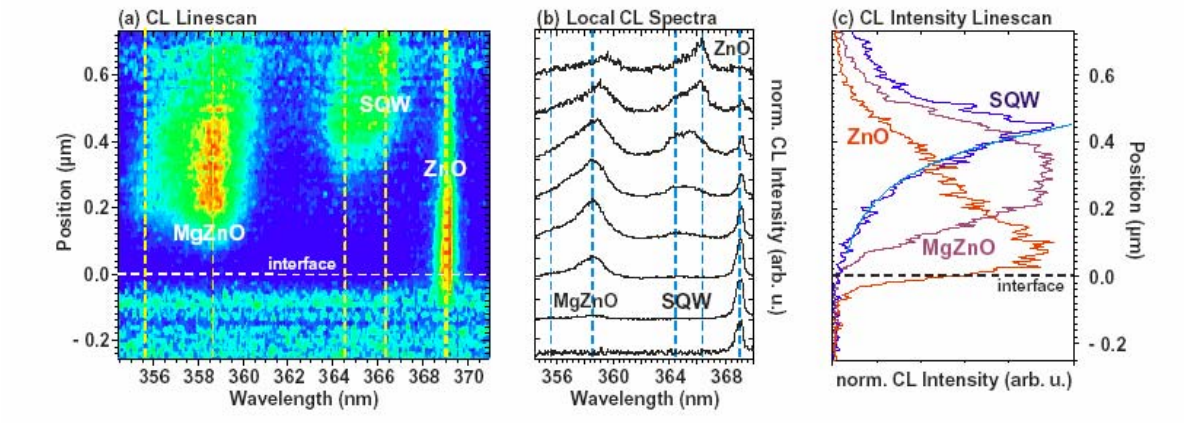

Fig. 1: *(a) Cross sectional CL line scan (T=5K) over the cleaved sample edge showing the layer sequence of the SQW structure (b) Local spectra taken from the identical line scan: a shift to lower energies (smaller [Mg]) in the MgZnO-luminescence and a change in intensity ratio of high to low energy line of the SQW-luminescence is visible when going from the interface to th esurface (c) Line scans of MgZnO-, SQW- and ZnO-intensity (taken from (a)): an ambipolar/excitonic diffusion length of L_D=130nm can be determined from the increase of SQW-intensity.*