Axial ZnO/$Zn_{1-x}Mg_xO$ multiple quantum wells on vertical ZnO microrods

Agnieszka Pieniążek,[1] Henryk Teisseyre,[1,2] Dawid Jarosz,[1] Bartłomiej S. Witkowski,[1] Anna Reszka,[1] Krzysztof Kopalko,[1] Adrian Kozanecki,[1] Marek Godlewski,[1,3] and Bogdan J. Kowalski[1]

[1]Institute of Physics, Polish Academy of Sciences, Warsaw, Poland
[2]Institute of High Pressure Physics, Polish Academy of Sciences, Warsaw, Poland
[3]Cardinal S. Wyszyński University, Warsaw, Poland

We report on optical properties of ZnO/ZnMgO multiple quantum well (MQW) heterostructures fabricated by plasma-assisted molecular beam epitaxy technique on the top of ZnO microrods grown by a microwave-assisted hydrothermal method. Spatially and spectrally resolved cathodoluminescence (CL) spectroscopy and imaging is employed for a detailed analysis of the optical properties of such axial heterostructures.

The CL emission spectrum from the axial ZnO/ZnMgO MQW heterostructure on the top of ZnO microrod (Fig. 1(a)) consists of a set of peaks which can be ascribed to emission contributions from the QWs with thickness from 1.5 to 8 nm. Peaks at the high-energy part of the spectrum at 3.47-3.60 eV originate from recombination in ZnMgO barrier.

The CL map of individual MQW heterostructure (Fig. 1(b)) composed of two images taken for the two spectral features (QW and barrier emission) show the spatial distribution of the emission bands with respect to position in the microrod. It is clearly visible that the ZnMgO layers are located only on the top end of the microrod. Emission at 3.36 eV is localized between the ZnMgO layers and most likely is related to recombination in QW.

In conclusion, the presence of the axial heterostructure grown on the top of ZnO microrods is confirmed by low-temperature CL. Luminescence lines are observed at the spectral positions expected for the QW and barrier emissions from the top part of the microrods. However, these lines show considerable spatial fluctuations in top-view monochromatic CL images, suggesting involvement of compositional fluctuation in the luminescence mechanism and random exciton localization. Investigations will be continued.

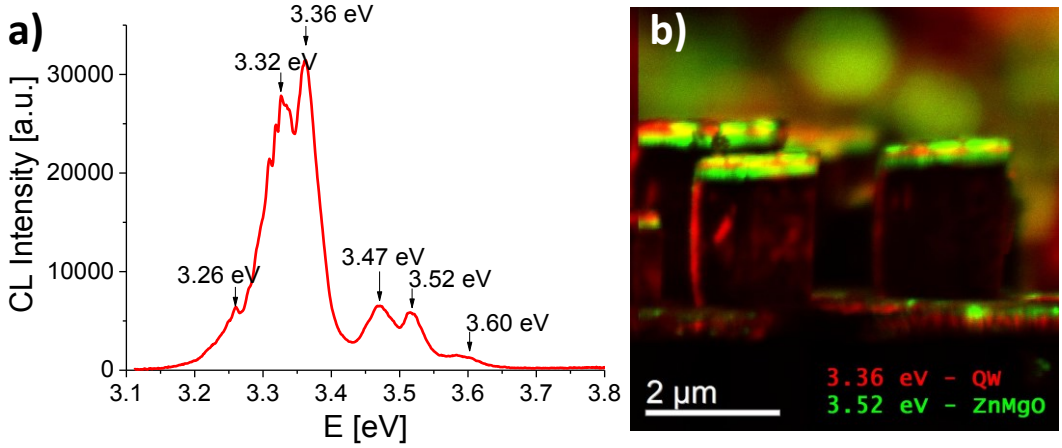

Fig. 1 (a) CL spectrum taken at 5K. The main spectral features are indicated by arrows. b) False colour CL image of the axial MQW heterostructure.

This work was partly supported by the Polish National Science Centre (NCN) Grant No. UMO-2016/21/B/ST5/03378 and No. UMO-2014/13/B/ST7/01773.