Influence of substrate temperature on incorporation of magnesium into ZnMgO layers grown by PA-MBE.

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ZnO as a wide band gap 3.37eV (at 300K) direct semiconductor has a large 60 meV exciton binding energy and exhibits stable excitonic emission at room temperature. ZnO due to its crystal symmetry, large exciton binding energy and large band gap comparable to that of GaN can be excellent candidate for use in visible and ultraviolet light emitters and detectors. Among many techniques used to grow ZnO and ZnMgO layers the PA-MBE (Plasma-Assisted Molecular Beam Epitaxy) has the most precise control of growth parameters such as growth rate, substrate temperature, Mg/Zn/O flux ratio. The energy band gap engineering is commonly realized by increasing magnesium concentration in ZnMgO layers.

Beside most important growth parameter which is the ratio of fluxes of metals to oxygen, the substrate temperature has crucial influence. When elevating the substrate temperature the Zn flux must also be raised to get the stoichiometric conditions.[1]

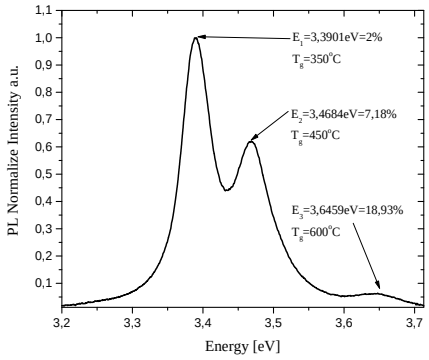

Fig.1 Photoluminescence spectra at 10K for ZnMgO thin films grown with the some Mg and Zn fluxes in different substrate temperature.

ZnO and ZnMgO epilayers on a-plane Al_2O_3 substrates were grown by PA-MBE. The influence of the substrate temperature on the composition of magnesium in ZnMgO epilayers is monitored with the corresponding photoluminescence spectra. The growth rate evolution versus substrate temperature was studied by means of *in situ* laser reflectometry. We found that the composition of magnesium in ZnMgO epilayers increases with increasing substrate temperature. The composition variation in the alloys as a function of the growth temperature can be explained by the difference of vapor pressure between Mg and Zn elements at high growth temperatures. At higher growth temperature Zn can be easily desorbed yielding Mg enriched films. Effectively, there is a higher Mg concentration as compared to Zn in the alloy films when grown at higher temperatures.[2] The effect of higher composition of magnesium in ZnMgO epilayers has been studied by PL and X-ray diffraction. This work was partly supported by the Polish National Science Centre (NCN) Grant No. 2014/13/B/St7/01773.

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[2] S. Choopun, et al., *Appl. Phys. Lett.* **80**, 1529 (2002).