Nanocomposites and nanomaterials

Crystal structure and optical characteristics of the ZnO film grown by MOCVD

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ZnO films are actively studied due to their unique properties for practical applications in the UV detectors, field emission displays, thin film transistors, solar cells, biosensors and etc. Two types of ZnO films were investigated: first one was grown by MOCVD at ambient pressure on glass substrate (spraying an organic solution of organometallic compounds and heated to 300C glass substrate); second film was grown by MBE on c - plane sapphire (Al_2O_3) substrate.

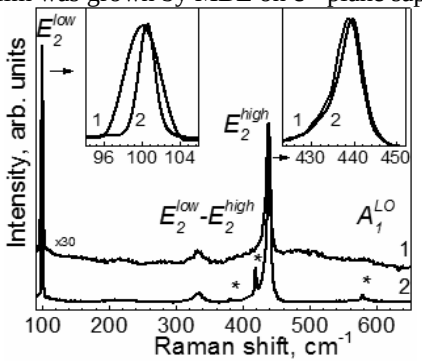

Fig.1. Micro-Raman spectra of ZnO films grown by MOCVD (curve 1) and MBE (curve 2). The inset shows frequency of E_2^{low} and E_2^{high} phonon modes. λ_{exc} = 488.0 nm.

The structural, phonon and emission properties of the ZnO films were investigated using X-ray diffraction, scanning electronic microscopy (SEM), Raman scattering and photoluminescence spectroscopy. Registration of (0002) strong peak in the X-ray diffraction spectra for ZnO films indicates the preferential crystallites orientation investigated films along (0001) direction. SEM image shows that ZnO-MOCVD film has fine-grained structure with the average grain diameter ~ 140 nm. At the same time ZnO-MBE film has a nanocrystalline structure with the grain size ~ 200 nm. The magnitude of elastic strain ε_{zz} (~$3.2 \cdot 10^{-3}$) and the quality of the crystal structure of ZnO-MOCVD film were determined based on the E_2^{high} phonon mode analysis in the Raman spectrum. The characteristics comparison of ZnO-MOCVD film with ZnO-MBE film was carried out. In result the possibility of growing sufficiently high-quality polycrystalline ZnO films using low-temperature technological method was demonstrated.