Investigation of strain relation and lattice dynamics in {CdO/MgO} superlattices grown by plasma-assisted molecular beam epitaxy

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Cadmium oxide (CdO) is a promising material for transparent conducting oxide (TCO) thin films due to its excellent performance regarding conduction [1]. It is characterized by high transparency in the visible spectrum, low resistivity and high carrier mobility [1]. In the TCO family, II-VI ternary oxide alloys have attracted considerable interest due to the possibility of modulating their band gaps in a wide range of values [1], what opens up the possibility of new applications in modern optoelectronic devices.

In this work we have studied a series of {CdO/MgO} superlattices (SLs) grown on *a*-, *c*-, *m*- and *r*-plane sapphire substrates by plasma-assisted molecular beam epitaxy (PA-MBE). The samples were measured by X-ray diffraction (XRD) and Raman spectroscopy techniques to obtain the strain distribution in SLs system as well as to study the lattice dynamics in the fabricated structures.

Figure 1 (a) shows the high resolution X-ray diffraction map (HRXRD) for selected sample grown on *r*-plane sapphire. It clearly reveals the periodic structure of the superlattice. Moreover, HRXRD maps allow to designate the accurate values of *a* and *c* lattice parameters for the series of samples. Furthermore, we can calculate the in-plane (ε_{xx}) and the out-of-plane (ε_{zz}) strain values.

Next, the Raman measurements were performed to examine lattice vibration mechanisms and crystalline quality of {CdO/MgO} SLs. The typical spectrum is shown in Figure 1 (b). First-order Raman modes are forbidden in the case of rocksalt compounds such as CdO and MgO. However, lattice mismatch between layers it the SLs induce strain in the structure. Disorder introduced by the strain may be the reason of the appearance of TO MgO mode.

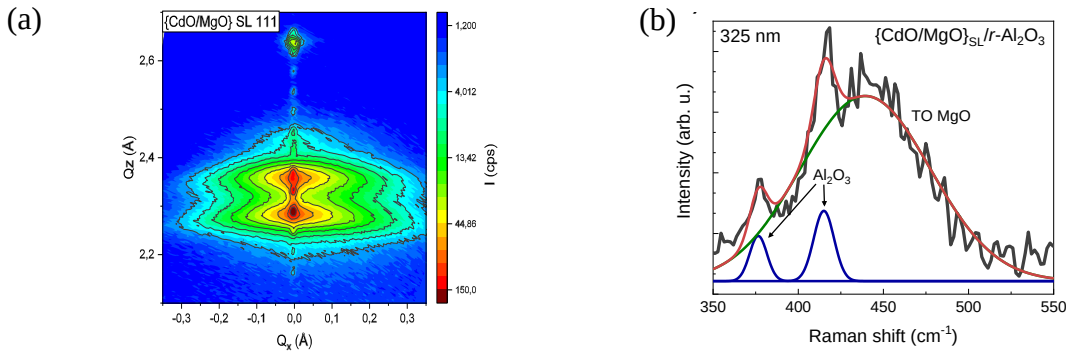

Figure 1. High resolution XRD maps measured for 111 CdO/MgO SL peak (a) and Raman spectra with an analysis of selected spectrum range carried out by fitting the data with Lorenz function (b) obtained for SLs on *r*-plane sapphire.

[1] U. Ozgur, Y.I. Alivov, C. Liu, A. Teke, M.A. Reshchikov, S. Dogan, V. Avrutin, S.J. Cho and H. Moroc, *J. Appl. Phys.***98**, 1 (2005).

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