Electrical and thermal transport properties of CdO and CdMgO alloys grown using plasma-assisted MBE technique

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CdO is one of the oldest transparent conducting oxides (TCOs) that attracts considerable attention for optoelectronic applications because of its high electron concentration, high electron mobility, and high transparency in the visible spectrum. Our recent reports on MBE-grown CdMgO alloys show that the lower optical bandgap of CdO (E_g=2.3 eV) can be overcome by alloying with wide bandgap MgO (E_g=7.5 eV) which is useful for light detection from visible to deep UV regimes [1,2]. However, to obtain maximum energy absorption, it is important to understand the relation between Cd and O_2 parameters during the growth process which influences the stoichiometry of the CdO and related ternary alloys. In the present studies, we investigated plasma-assisted molecular beam epitaxy (PA-MBE) grown CdO and CdMgO ternary alloys. Temperature-dependent Hall measurement revealed the maximum mobility of 352 $cm^2V^{-1}s^{-1}$ achieved at room temperature with a carrier concentration of about 4.5 x 10^{19} cm^{-3}. The thermal transport properties, such as thermal conductivity, thermal diffusivity, and thermal boundary resistance, were measured using photothermal infrared radiometry. We believe that our findings may provide valuable insight for a better understanding of CdMgO alloys which can open up new prospects for designing novel optoelectronic devices.

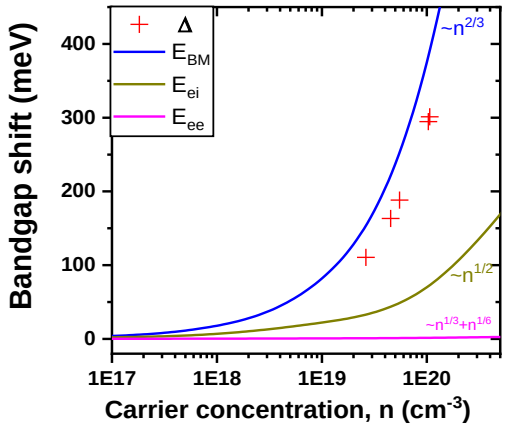

Figure 1. Bandgap shift as a function of carrier concentration
(Total shift $\Delta = \Delta E_{BM} - \Delta E_{BGN}$ is denoted by + sign)

The work was supported by the Polish NCN project DEC-2021/41/N/ST5/00812 and DEC-2021/41/B/ST5/00216.

[1] A. Adhikari, A. Lysak, A. Wierzbicka, P. Sybilski, A. Reszka, B.S. Witkowski, and E. Przezdziecka, *Mater. Sci. Semicond. Process.* 144, 106608 (2022).
[2] A. Adhikari, A. Wierzbicka, A. Lysak, P. Sybilski, B. S. Witkowski, and E. Przezdziecka. arXiv preprint arXiv:2210.11785 (2022).