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Bandgap engineering and structure analysis of ZnO/ Al_2O_3 superlattices grown by atomic layer deposition. W.C. HSIEH, Q.Y. CHEN, P.V. WADEKAR, C.F. CHANG, Department of Physics, National Sun Yat-Sen University, H.C. HUANG, Department of Material Science and Optoelectronics, National Sun Yat-Sen University, C.M. SHIAU, Y.P. CHENG, Y.S. HONG, C.Y. DANG, P.C. KUNG, C.H. LEE, S.H. HUANG, Z.Y. WU, Y.Y. LIANG, C.M. LIN, S.T. YOU, L.W. TU, Department of Physics, National Sun Yat-Sen University, N.J. HO, Department of Material Science and Optoelectronics, National Sun Yat-Sen University, H.W. SEO, Department of Physics, Jeju National University, W.K. CHU, Texas Center of Superconductivity and Department of Physics, University of Houston — ALD-grown ZnO/Al_2O_3 superlattices (SLS) as analyzed by XRR assisted with GenX fittings exhibit a consistent mass density for the ZnO layers of 5.6 g/cm^3, largely that of the bulk crystal. However, for Al_2O_3, the value is ˜2.95 g/cm^3 versus the ideal 3.95 g/cm^3. This discrepancy suggests a highly porous Al_2O_3, possibly due to the presence of hydrogen in an AlO(OH) amorphous boehmite phase. TEM imaging portrays the periodic structures consistent with the XRR findings. The ZnO layers are c-textured while Al_2O_3 amorphous. Room-temperature CL measurements showed decreasing ZnO bandgap as the Al_2O_3 cycles increased, hinting at feasible bandgap engineering through SLS structural variations. Amorphous Al_2O_3 is known to have a smaller bandgap of 5.7-7.1 eV as compared to 7.1-8.8 eV for bulk crystals. CL also showed a peak at ˜5.1 eV, thus consistent with our conjecture of the am-Al_2O_3.

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