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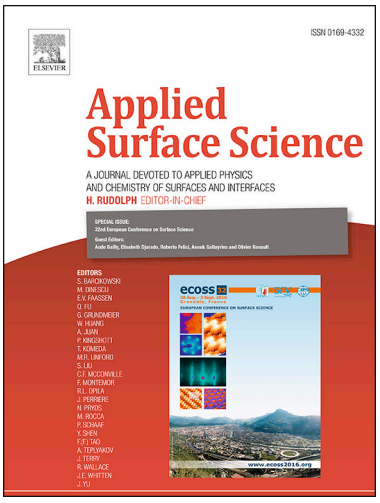

Full Length Article

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Coherent InAs/CdSe and InAs/ZnTe/CdSe heterovalent interfaces: electronic and chemical structure

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Abstract

The electronic and chemical structure of two types of nearly lattice-matched InAs/(Cd,Zn)(Se,Te) heterovalent interfaces grown coherently by molecular beam epitaxy are investigated by soft x-ray photoelectron spectroscopy (SXPS) and secondary ion mass-spectroscopy (SIMS). The valence band offset (VBO) at the CdSe/InAs heterointerface formed close to the Cd/Se~1:1 stoichiometric conditions is determined to be 1.02 ± 0.08 eV. The incorporation of a 3-monolayer-thick ZnTe intermediate layer between InAs and CdSe leads to an increase in the VBO between InAs and CdSe by approximately 0.17 eV. The dominant chemical bonds at the interface have been established to be In-Se or In-Te ones from analysis of SXPS spectra recorded at different excitation energies (100-650 eV) and surface sensitive SIMS study, while the signals from Cd(Zn)-As bonds are negligible. The diffusion of the InAs substrate components to the CdSe layer is rather weak: in particular, the concentration of In and As atoms drops in the CdSe layer down to 1% at the distance from the interface of 1 nm. Introduction of the 1-nm-thick ZnTe layer slows down the As surface segregation even more.

Keywords: heterovalent interface, InAs/ZnTe, InAs/CdSe, molecular beam epitaxy, soft x-ray photoelectron spectroscopy, energy diagrams, chemical bonds.

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