Journal of Physics and Chemistry of Solids
Volume 66, Issue 11, November 2005, Pages 1974-1977

Exciton spectra, valence band splitting, and energy band structure of $CuGa_xIn_{1-x}S_2$ and $CuGa_xIn_{1-x}Se_2$ crystals

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https://doi.org/10.1016/j.jpcs.2005.09.029

Abstract

Exciton spectra are studied in CuGaXIn1−XS2 solid solutions by means of photoreflectivity and wavelength modulation spectroscopy at liquid nitrogen temperature. The exciton parameters, dielectric constants, and free carrier effective masses are deduced from experimental spectra by calculations in the framework of a model taking into account the spatial dispersion and the presence of a dead-layer. The crystal field and spin orbit valence band splitting is calculated as a function of X taking into account the energy position of excitonic lines. The energy band structure of CuGaXIn1−XS2 and CuGaXIn1−XSe2 compounds is derived from optical spectra at photon energies higher than the fundamental band gap. The energies of optical transitions are tabulated for X values from 0 to 1.