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PHOTONIK SEMINAR

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Magneto-optics of IV-VI topological heterostructures

IV-VI semiconductors crystallize in the rocksalt structures. They have been extensively studied (G. Bauer et al) by magneto-optics [1]. Their band structure is well known with band extrema at the L points : in PbTe, PbSe the valence band is L6+ and the conduction band is L6-. The effective masses are light, allowing a strong Landau quantization, and the materials are naturally highly doped. IV-VI alloys such as Pb1-y SnyTe, Pb1-x SnxSe display a continuous decrease of their bandgap, going to zero at x = 0.16 in the selenides. Beyond the critical concentration, there is an inversion in the band ordering : in Se rich Pb1-x SnxSe, L6+ (L6-) becomes the conduction (valence band).
It is possible to grow by MBE good quality IV-VI heterostructures. This talk will report on the magneto-optical investigation of Pb1-x SnxSe/Pb1-tEutSe. The Eu alloy is the barrier-acting material and displays the normal (PbSe) band ordering. The investigation of inverted/ normal heterostructures clearly evidences the formation of interface states with wavefunctions that peak at the interfaces. These are genuine characteristics of topological materials. The interface states are composed of evanescent states in both kinds of layers and their eigenenergies are found in the energy segments inaccessible in conventional QW's.
It is possible to trigger a topological → normal transition by temperature or magnetic field. Magneto-optics allows a detailed study of the band parameters during that transition. It appears that the bandgap undergoes an anomaly at the transition.
This work has been performed in collaboration with G. Krizman, Y. Guldner, L.A. de Vaulchier, R. Ferreira in Paris and G. Springholz and G. Bauer in Linz.

[1] see e. g. G Bauer, H. Pascher and W. Zawadzki. Semicond. Sci. Technol. 7, 703 (1992)

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Seminarraum Institut für Photonik
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