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Exchange coupling in ferromagnetic (In,Mn)Sb

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In $(III, Mn)V$ ferromagnetic semiconductors the randomly distributed Mn^{2+} dopants provide the magnetic moments, and at the same time act as a source of valence band holes that mediate the Mn^{2+}-Mn^{2+} interactions [1-3]. In this work we demonstrate that - by using hydrostatic pressure to continuously tune the wave function overlap - one can control the strength of ferromagnetic coupling, and can even induce the ferromagnetic phase in an initially paramagnetic alloy.

Most of the experiments were performed on (In,Mn)Sb [4-6], where the influence of the hydrostatic pressure on the magnetoresistance and the anomalous Hall effect (AHE) was also studied in detail. Based on simultaneous investigation of the field dependence of the magnetoresistance and the magnetization a microscopic picture is proposed for the magnetic scattering process. The large negative magnetoresistance observed below T_C is attributed to a first order scattering of the spin-polarized holes on a small fraction of isolated (paramagnetic) Mn^{2+} ions. Above the phase transition the spin polarization of the carriers is lost, and a qualitatively different, second order process emerges.

Keywords : exchange coupling, high-pressure experiments, magnetic scattering