The effect of high hydrostatic pressure on the paramagnetic-ferromagnetic phase transition in (Ga,Mn)As

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(Ga,Mn)As is one of the most frequently studied dilute magnetic semiconductor nowadays. The origin of ferromagnetism in this material is explained by the *p-d* Zener model. The paramagnetic – ferromagnetic phase transition temperature (T_C) depends on the local *p-d* exchange interaction (through hybridization) and the free-hole concentration. Since the strength of hybridization depends on the lattice parameter, the application of high hydrostatic pressure, which effectively reduces the lattice constant, should increase the T_C and provide an invaluable insight into the origins of the magnetic coupling in this material.

The effect of pressure on the paramagnetic – ferromagnetic phase transition in (Ga,Mn)As is studied by electrical resistivity measurements under semi-hydrostatic pressure up to 10 GPa at temperature range 50 – 250 K in diamond-anvil cell (DAC). Nominally containing 11% of Mn a high quality epitaxially grown (Ga,Mn)As layer on (100) GaAs substrate is placed on especially designed electrical contacts deposited on one of the diamond. The rock-salt is used as a pressure – transmitting medium. The metal gasket used for DAC was covered by an insulating layer. The phase transition temperature is estimated from the position of maximum of the temperature derivative of the resistivity of the studied samples. The results of measurements show the increase of T_C with the pressure at the rate of about 2 K/GPa for the sample with the phase transition temperature of 150 K at ambient pressure.

The results show that the hydrostatic pressure application would allow obtaining a significant increase of the paramagnetic-ferromagnetic phase-transition temperature for (Ga,Mn)As layers of about 25 K before the structural phase transition occurs at about 12 GPa.

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