A New Type of Low Temperature Conductivity in Semiconductors.

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Studies of transport properties of p-InSb single crystals doped with manganese in the range of manganese concentration $N_{Mn}=1*10^{17}\div2*10^{17}cm^{-3}$ revealed that resistivity-temperature dependence (ρ-T) in p-InSb(Mn) crystals in the temperature range T=10÷1,5K can be described by exponential quadrant function $\boldsymbol{\rho=\rho_0\ exp(\Delta_1/kT)^2}$ where Δ_1 increased with the decrease of manganese concentration from Δ_1=0,25meV to zero and ρ_0 varied from ~0,1Ω to 0,04Ωcm in the above concentration range. Hall effect, magnetoresistivity and transport studies at hydrostatic pressure [1] showed that unusual ρ-T dependence could be related to interplay of two charge carriers types, i.e. electrons with spin s=1/2 and heavy holes with s=3/2. It gave the ground for the model of excitonic insulator [2]. Following the Keldysh and Kopaev's model we suggest that ρ-T dependence in the temperature range 10÷1,5K was the result of insulating permanent excitons input into conductivity. So with the temperature lowering we observed not only exponential increase of resistivity determined by exciton binding energy Δ_1 but also increase of resistivity caused by exponential decrease of charge carriers concentration . At temperature below ~1,5K we observed Bose condensation of excitons and formation of excitonic insulator which gap energy Δ approximately three times exceeded exciton binding energy Δ_1.

[1] Teubert, J., Obukhov, S. A., Klar, P. J. & Heimbrodt, W. *Phys. Rev. Letters* **102**, 046404-046407 (2009).
[2] Keldysh, L. V. & Kopaev, Yu. V. *Sov. Phys. Solid State* **6**, 2219-2224 (1965).