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Magnetoresistance due to inelastic spin-flip cotunneling within Coulomb blockade regime in III-V semiconductor / MnAs nanoparticle heterostructures RYOTA AKIYAMA, SHINOBU OHYA, PHAM NAM HAI, MASAAKI TANAKA, Dept. of Electrical Eng. and Information Systems, The Univ. of Tokyo — Inelastic spin-flip cotunneling is a key to understand the spin-dependent single-electron transport in the ferromagnetic nanoparticles systems. We fabricated a heterostructure consisting of Al/ AlAs/ ferromagnetic zinc-blende (ZB) MnAs nanoparticles embedded in GaAs / GaAs:Be on a GaAs(001) substrate, where electrons are expected to go through only one nanoparticle during tunneling. By analyzing the $I-V$ data at various temperatures T, we found that inelastic cotunneling is dominant when T <60 K. The ratio of the inelastic cotunneling energy E to the thermal energy kT, estimated by the $I-V$ data, was remarkably increased with decreasing T. We observed clear magnetoresistance (MR) up to ∼3% (at 1T), and MR was also increased with decreasing T. The shape of the *MR-T* curve was quite similar to that of the *E/kT - T* curve, which strongly suggests that MR is induced by the spin-flip process due to inelastic cotunneling. From the *E/kT - T* curve, the energy needed for the spin-flip process is estimated to be ∼0.04 meV, which corresponds to ∼3.3% of the inelastic cotunneling energy. This work was partly supported by the Grant-in-Aids for Scientific Research, Special Coordination Programs by JST, FIRST Program, and JSPS Fellowship.

Ryota Akiyama
Dept. of Electrical Eng. and Information Systems, The Univ. of Tokyo

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