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Electrical spin injection and detection by ballistic transport in MnAs / GaAs / GaAs : MnAs spin–valve hybrid heterostructures PHAM NAM HAI, YUSUKE SAKATA, MASAFUMI YOKOYAMA, Dep. of Electronic Eng., The Univ. of Tokyo, SHINOBU OHYA, MASAAKI TANAKA, Dep. of Electronic Eng., The Univ. of Tokyo; JST — Electrical spin injection and detection by ballistic transport of spin-polarized carriers in ferromagnet (FM) / semiconductor (SC) / ferromagnet (FM) hybrid structures are key issues in semiconductor-based spintronics. By using ballistic transport of spin-polarized carriers, we can improve the spin injection / detection efficiency without using a high tunnel barrier at the FM/SC interface that decreases the current driving capability when used in active devices. In this paper, we report on the spin injection and detection by ballistic transport in perpendicular spin-valve hybrid heterostructures consisting of MnAs (20 nm) / GaAs (10 – 30 nm) / GaAs:MnAs (5 nm) grown by molecular beam epitaxy. The GaAs:MnAs layer contains ferromagnetic MnAs nanoclusters embedded in a GaAs matrix, and acts as a spin injector and a spin detector. Several % of spin-valve MR ratio was clearly observed up to 300 mV at temperature lower than 90 K. Considering the fact that all the junctions showed ohmic current-voltage characteristics, the spin-valve MR would be 10^{-6} for purely diffusive transport regime. Consequently, the spin-valve MR signal of several % is caused by the ballistic transport of spin-polarized carriers in the GaAs layer.

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