Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Huge tunneling magnetoresistance (>18300%) in semiconductor based magnetic tunnel junctions with zinc-blende MnAs nanoparticles
PHAM NAM HAI, BYUNGHO YU, Dep. of Electronic Eng., The Univ. of Tokyo, SHINOBU OHYA, MASAAKI TANAKA, Dep. of Electronic Eng., The Univ. of Tokyo; JST — Zinc-blende (ZB) MnAs nanocrystallite is a new prospective material for semiconductor spintronics, since it is expected to be haft-metallic. However, there is no report on the magneto-transport characteristics of ZB MnAs nanoparticle system. In this paper, we report on the huge tunneling magnetoresistance (TMR) effect in MBE-grown magnetic tunnel junctions (MTJs), whose structure is (from the top to the bottom) hexagonal MnAs film (20 nm) / GaAs (1 nm) / AlAs (2.1 nm) / GaAs:MnAs (10 nm), revealing the haft-metallicity of ZB MnAs nanocrystallite. Here, the GaAs:MnAs layer contains ZB MnAs nanoparticles embedded in a GaAs matrix. The tunnel resistance decreases sharply with increasing the magnetic field, resulting in a huge TMR ratio = $(R_{max} - R_{min})/R_{min} > 18300\%$. The TMR ratio decreases quickly with increasing the bias voltage and temperature, but survives up to 100 K. Such a huge TMR effect can be explained by an unique combination of Coulomb Blockade effect and large Zeeman splitting in half-metallic ZB MnAs nanoparticles. A magnetic-field dependent electromotive force emerged from those MTJs was also observed.

Pham Nam Hai
Dep. of Electronic Eng., The Univ. of Tokyo

Date submitted: 27 Nov 2007 Electronic form version 1.4