Transport properties of metal/insulator/semiconductor tunnel junctions

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Metal/insulator/semiconductor (F/I/S) tunnel junctions were grown by using a sputtering method on GaAs and Si substrates. The base pressure was less than 5×10^{-8} Torr. The insulating layer was formed by oxidizing 1.4~2.0 nm Al layers, and NiFe, CoFe, and Cu were used for materials of the top metal layer. The 50μm×50μm size junctions were patterned by photolithography and ion milling processes. The *I-V* curves in Fig. 1. show the characteristics of diodes for $Si/Al_2O_3/CoFe$ junctions with different Al_2O_3 thickness. The thickness of each layer in Fig. 1 is given in Å. For $Si/Al_2O_3/CoFe$ junctions, the optimal diode characteristic was obtained when the thickness of Al layer was 16 Å. In order to observe the spin dependent tunneling from the semiconductor to the ferromagnet, circularly polarized light was illuminated on $GaAs/Al_2O_3/CoFe$ tunnel junctions. An optical chopper, which was locked with a Lock-in amp, was used to discriminate the dark current. By this technique, only photo current was measured. The photo-currents were plotted as functions of bias voltage for each polarization. Our results indicate that a small portion of spin information is conserved when electrons tunnel from the semiconductor to magnetic layer.

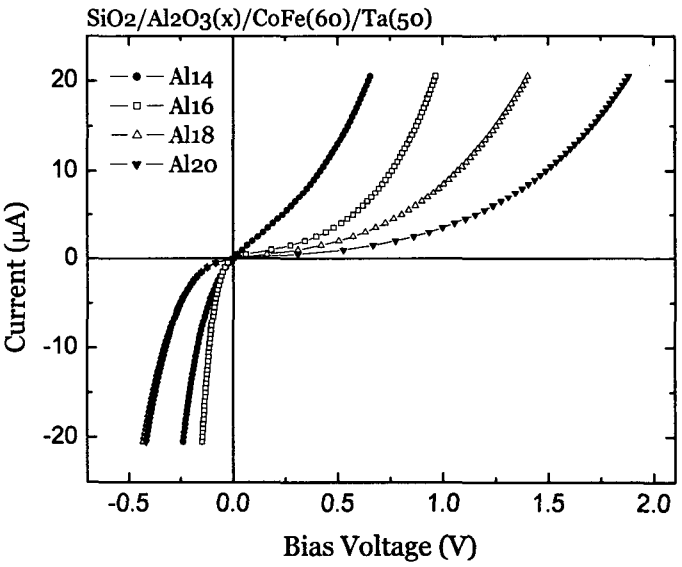

Fig.1. Bias dependence of Si/ Al_2O_3/CoFe for the different thickness of Al layer.