

Temperature dependence of magneto-transport properties in

$\text{Co}_2\text{Fe}(\text{Ga}_{0.5}\text{Ge}_{0.5})/\text{Cu}$ lateral spin valves

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The lateral spin valve (LSV) has been considered as one of candidates for read sensor applications in high density hard-disk drives^[1,2]. The measure of LSV performance, the spin signal (ΔR_S), is mainly dictated by the spin polarization of ferromagnetic layers and spin diffusion length of non-magnetic channels. On the pursuit of large spin signals, we prepared ohmic contact LSVs utilizing highly spin polarized $\text{Co}_2\text{FeGa}_{0.5}\text{Ge}_{0.5}$ (CFGG) layers and Cu channels.

The starting multilayer stack of MgO (001) sub./Cr (3nm)/Ag (10nm)/CFGG (25nm)/Cu (10nm)/SiO₂ (2nm) was prepared by ultra-high vacuum magnetron sputtering system. To induce the B2 ordered structure of the CFGG layer, the multilayer stack was annealed at 500°C. The LSV devices with sub-micron scale dimensions were prepared from the multilayer stack by top-down microfabrication process.

At room temperature (300 K), the spin signal of around 13.2 mΩ was observed for center-to-center ferromagnetic wires distance (d) of 400 nm (Fig.1). The spin signal increases as measurement temperature decreases up to 36K, over which the downturn was observed (Fig.2). The spin signal of 56.2 mΩ was achieved at 36K, four times larger than that at room temperature, mainly due to the high spin polarization of CFGG layer at low temperature. Based on the 1-dimensional spin diffusion model^[3], we will discuss the temperature dependence of CFGG spin polarization as well Cu spin diffusion length to clarify the origin of non-monotonic trend of spin signals in CFGG/Cu LSVs.

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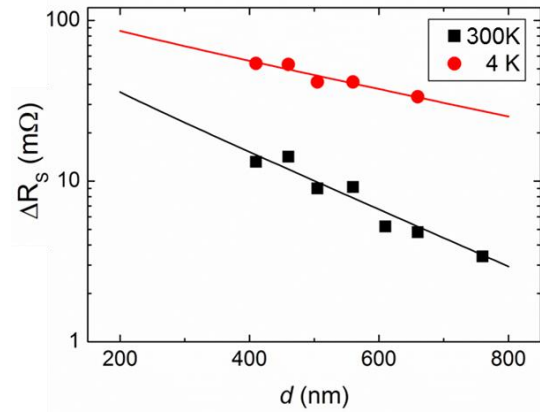


Figure 1. The spin signals ΔR_S as a function of d for CFGG/Cu LSVs measured at 300 K and 4 K.

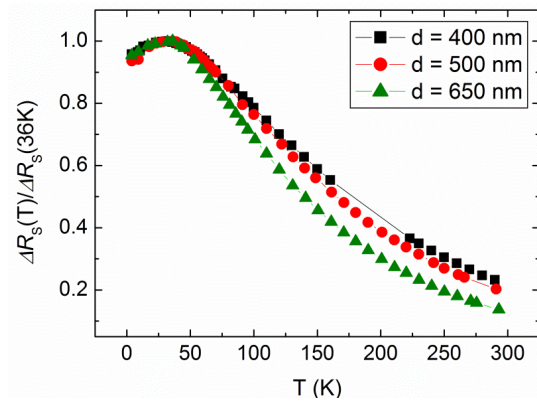


Figure 2. The normalized spin signals for CFGG/Cu LSVs with various d measured at 4-300K.

References

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