Spin-dependent transport property of organic-ferromagnetic hybrid junctions using [6]cyclo-2,7-naphthylenes

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Recently, the hybrid structure of organic and ferromagnetic materials attracted much attention from the viewpoint of spin injection into the organic molecules[1,2] and new interface effects[3,4,5]. However, there were only few reports of room temperature operation, thus it is needed to explore the hybrid structure with new materials/molecules which shows remarkable spin-dependent transport at room temperature. Here, we focus on the [6]cyclo-2,7-naphthylenes (CNAP) (Fig. 1), which is a new molecule synthesized recently[6]. CNAP has an excellent thermal stability (~600℃), cyclic shape, and bipolar transport property. We report the fabrication of hybrid junctions with the CNAP spacer and the characterization of spin-dependent transport properties. The samples were prepared by organic-inorganic hybrid multi-chamber deposition system for organic light emission diode (OLED) which is equipped with an in-situ shadow-mask exchange system. The sample structure is Co(50 nm, sputtering)/AlOx(2 nm, plasma oxidation)/CNAP(1-20 nm, thermal evaporation) / NiFe (30nm, EB evaporation), The samples are cross-shape with the junction area of 1.5 × 1.8 mm^2. Magnetoresistance (MR) effects of the samples were characterized by a standard four probe method with different temperatures. Figure 2 shows the MR curve for the junction with the 10-nm-thick CNAP with various temperatures. The MR ratio of 1.6, 3.2 and 4.5% were observed at 300, 100 and 5 K, respectively, The MR curves correspond well to the magnetic hysteresis curves for Co and NiFe electrodes and also junctions resistance is remarkably large (17-45 kOhm・mm^2), thus it is considered that this MR effect originates from spin-dependent transport via CNAP molecules.

This work was partially supported by ERATO (JST), Murata Foundation, and WPI-AIMR Fusion research program. We thank Mr. H. Kiso for his help with the device fabrications.

Reference: [1] V.A. Dediu, *et.al.*, Nat. Mater. **8**, 707(2009). [2]X. Zhang, et. al., Nature Comm. 4:1392 doi: 10.1038/ncomms2423 (2013).[3] C. Barraud, *et. al.* , Nat. Phys. **6**, 615 (2010).[4] X. Zhang, *et.al.* Appl. Phys. Lett. **99**,162509(2011) [5]K. V. Raman, et. al., Nature 493, 509(2013) [6] W. Nakanishi *et. al.* Angewandte Chemie **123**, 5435 (2011)

Fig. 1 Molecular structure of [6]CNAP[6]

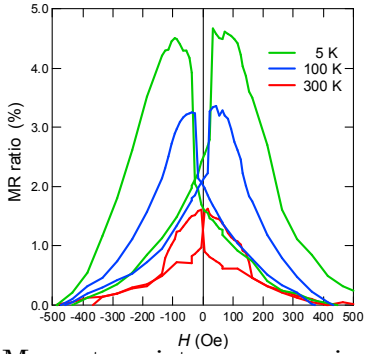

Fig. 2 Magnetoresistance curve in Co/AlOx / CNAP(10 nm)/NiFe junction