Magnetoresistance effect on single-molecule junction of Au/benzene-dithiol/Au at room temperature

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A magnetic field effect on charge transport in organic materials sandwiched between non-magnetic electrodes, called organic magnetoresistance (OMAR), has attracted attentions [1]. The proposed mechanisms of OMAR were related to the charge transport in the local magnetic field accessed by hyper-fine coupling, e.g., formation of bipolarons, electron-hole pairs and/or excitons in molecular films [2]. It is intriguing to examine the OMAR of micro- to nano-scale molecular aggregates or of single molecules. The OMAR of self-assembly monolayers of oligophenylene with thiol anchoring on gold has been reported by Xie et al, in which the authors discussed the origin as the difference in transmission barriers for singlet and triplet state at the interface [3]. We reported the MR effect in Au/hexane-dithiol (HDT)/Au single-molecule junctions [4]. We currently associated the effect as the magnetism at the interface due to charge transfer between Au and S bonds as was pointed out previously [5,6].

Here we demonstrated the MR effect on a single-molecule junction of Au/benzene-dithiol (BDT)/Au and examined the effect of π-orbital onto OMAR. MR measurement was conducted under Ar atmosphere at room temperature with a mechanically controllable break junction (MCBJ) technique as shown in Figure 1 [7]. During the junction breakdown process, we applied DC bias of 30 mV. The magnetic field sweep was applied up to ± 95 mT as the conductance value became below 1 G_0 ($G_0 = 2e^2/h$) which 1 G_0 refers to the formation of gold atomic junction. Figure 2 shows the change of electrical resistance under the magnetic field. The resistance decreased with the magnetic field, while the Au/HDT/Au junction showed an increase. The factor to determine the sign of OMAR will be discussed.

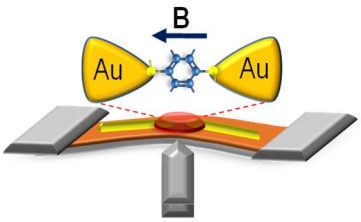

Figure 1. Set-up for MCBJ measurements under magnetic field.

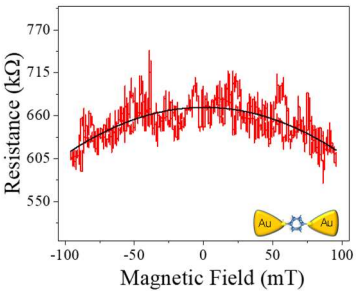

Figure 2. MR curve of an Au/BDT/Au junction.

Reference:

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