Electron Spin Resonance Measurement of an Adsorbed Single Molecule Magnet Terbium Phthalocyanine ($TbPc_2$)

T. Komeda[1], R. Kawaguchi [1], K. Hashimoto [2], T. Kakudate [3], K. Katoh [4], M. Yamashita [5,6]

[1]IMRAM, Tagen, Tohoku University [2]Department of Physics, Tohoku University, [3] Department of Industrial Systems Engineering, Hachinohe College, [4]Department of Chemistry, Josai University, [5]Department of Chemistry, Tohoku University, [6] School of Materials Science and Engineering Nankai University

tadahiro.komeda.a1@tohoku.ac.jp

The application of magnetic molecules to the materials of the devices for the quantum information process attracts attention. It is critical to make the sharp spin state of the molecule coupled efficiently with the electric current and substrate. The double-decker phthalocyanine complex of bis(phthalocyaninato)terbium(III) ($TbPc_2$) molecule showed intriguing single-molecule magnet (SMM) behavior, which was demonstrated to be served after transferred on the substrates of Cu(100)[1].

A scanning tunneling microscope and spectroscopy (STM/STS) are employed to examine the structural configuration and the spin state. The experiment was done in UHV conditions at the temperature of 400 mK. RF signal and outer magnetic field are introduced to the tunneling junction between the spin-polarized tip and the Cu(100) substrate. NaCl film of several monolayers is inserted as a thin interface layer.

The schematic illustration is in Fig. 1, with STM images of the TbPc2 molecule. As shown in Fig. 1(d), a sharp resonance feature is observed as an enhancement of the tunneling current. As shown in Fig. 2, the resonance condition shows a Zeeman condition with g~2.0 representing the Pc ligand's delocalized unpaired π orbital spin.

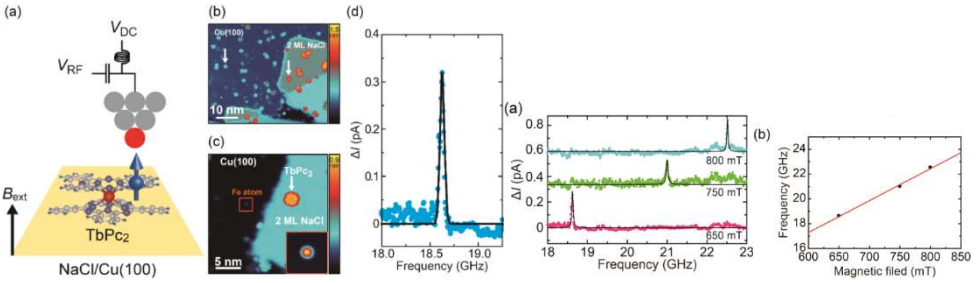

Fig 1: (left) (a) Schematics of ESR-STM. (b) Single-molecule magnet TbPc2 film and (c) isolated TbPc2 on NaCl film. Fig. 2 (right) (a) Enhanced tunnelling current at the resonant condition of RF signal and the magnetic field. The RF frequency at the resonant condition shifts with the magnetic field, which is summarized in (b).

[1] Kawaguchi, Komeda et al., Nano Lett., **23**, 213-219 (2023).