Single Molecular Resonant-Tunneling Transistor (SMRT^2) based on Quinoidal Fused Oligosilole Derivative (Si-2*2) bridged between H-ELGP Pt-based Nanogap Electrodes

[O] Seung Joo Lee[1], Jaeyeon Kim[1], Tomohiro Tsuda[2], Ryo Shintani[2], Kyoko Nozaki[3], and Yutaka Majima[1]

[1] Laboratory for Materials and Structures, Tokyo Institute of Technology, Japan
[2] Division of Chemistry, Department of Materials Engineering Science, Osaka University, Japan
[3] Department of Chemistry and Biotechnology, The University of Tokyo, Japan
E-mail: lee.s.as@m.titech.ac.jp

Nowadays, many researchers have proposed the next-generation transistors toward 3nm technology node to obtain a good on/off ratio. We have reported single molecular resonant tunneling transistor (SMRT^2) operation based on rigid π-conjugated molecule and hemispheric electroless Au plated (H-ELGP) Pt-based nanogap electrodes. Here, we introduce Si-bridged quinoidal fused oligosilole derivative (Si-2*2) which has a 34 π-conjugated molecular structure with four silicon atoms depicted in **Figure 1**. Si-2*2 is a strong candidate of functional group for molecular transistors due to structural stability for change in the valence charge.

Si-2*2 was bridged between hemispheric electroless Au-plated (H-ELGP) nanogap Pt electrodes through thiol groups at the both ends. Gate voltage dependence of I_d-V_d characteristics are shown in **Figure 2**. I_d-V_d characteristics are symmetrical to the V_d = 0, extremely high current, and clearly depended on gate voltage. These results indicate the operations of the bridged single molecular resonant tunneling transistor.

This study was partially supported by MEXT Elements Strategy Initiative to Form Core Research Center from the Ministry of Education, Culture, Sports, Science, and Technology (MEXT), Japan; and the BK Plus program, Basic Science Research (NRF-2014R1A6A1030419).

[1] R. Shintani *et al.*, *J. Am. Chem. Soc.*, **139**, 3861 (2017).
[2] O. Chun *et al.*, *ACS Omega* **3**, 5125-5130 (2018)

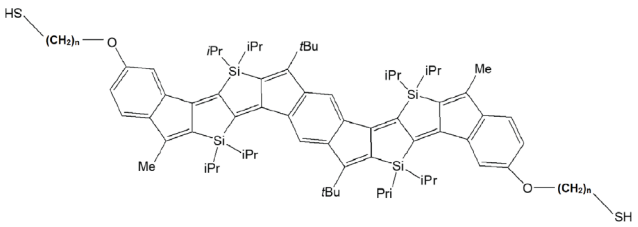

Fig 1. Molecular structure of **Si-2*2**

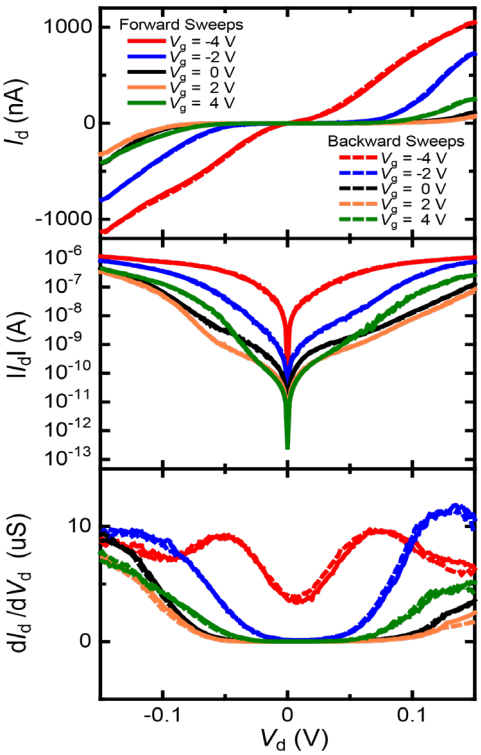

Fig 2. Gate voltage dependence of I_d-V_d and dI_d/dV_d-V_d characteristics of Si-2*2 SMRT^2 measured under the 9K.