Quinoidal Fused Oligosilole Derivative Single Molecular Transistor

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Molecular transistors have been considered as one of the alternative for a next-generation transistor because a π-conjugated molecule has its unique structure with a few nm scale, and the molecular energy levels can be in use. Here, Si-bridged quinoidal fused oligosilole derivative **(Si-2)** which has an 20π-conjugated structure with two silicon atoms (**Figure 1**) was introduced between electroless Au-plated (ELGP) nanogap Pt electrodes to fabricate molecular transistor. This quinoidal fused oligosilole derivative is very stable under charged states and air ambient condition because silicon atoms can effectively suppress molecular interactions.[1] The width and length of **Si-2** are 1.6 nm and 1.8 nm, respectively. Two SH groups can directly chemisorb onto Au electrodes by strong S-Au bonding.[2] I_d-V_d characteristics and dI_d/dV_d-V_d characteristics clearly showed gate voltage dependence as shown in **Figure 2a**. I_d-V_g characteristics under the application of drain voltages also showed gate oscillation (**Figure 2b**). Consequently, **Si-2** single molecular transistor operations have been reproducibly measured at 9 K.

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[1] R. Shintani et al, *J. Am. Chem. Soc.*, **139**, 3861 (2017).
[2] Y. Majima et al, *J. Am. Chem. Soc.* **135**, 14159 (2013).

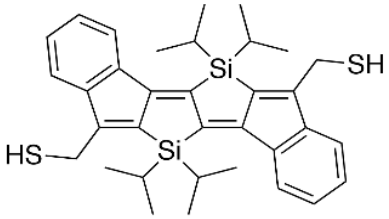

Fig 1. Molecular structure of **Si-2**.

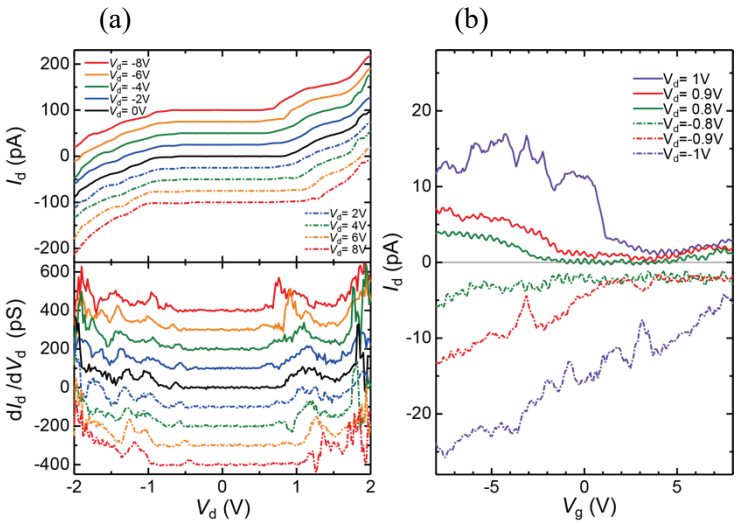

Fig 2. (a) Gate voltage dependence of I_d-V_d and dI_d/dV_d-V_d characteristics, (b) I_d-V_g characteristics under drain voltages of 1, 0.9, 0.8, -0.8V, -0.9V and -1V.