

Molecule/Au nanoparticle/molecule based triple dots single-electron transistor

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Based on π -conjugated derivative with linker groups at the both ends, the stability diagrams of single-molecule single-electron transistors (SM-SETs) have been reported^[1-2]. Recently, we have developed the fabrication process of the heteroepitaxial spherical (HS-) Au/Pt nanogap electrodes, which enable us to demonstrate SM-SETs operation^[3,4].

Here, we demonstrate the electrical properties of carbon-bridged oligo(phenylenevinylene) COPV2-based triple dots-SET. We exposed the patterns of nanogap electrodes on an EBL resist-coated SiO₂/Si substrate employing EBL apparatus. After an EBL resist development process, we deposited Pt onto the substrate by e-beam deposition and implemented a lift-off process to fabricate ultra-fine Pt-based nanogap electrodes. We treated electroless Au plating (ELGP) to form HS-Au/Pt nanogap electrodes. Finally, COPV2 derivatives were chemically bonded between HS-Au/Pt nanogap electrodes.

We measured the electrical properties of the COPV2 derivative transistors and characterized their structure by SEM. The experimental stability diagrams suggest a COPV2/Au nanoparticle/COPV2-based triple-dot single-electron transistor, which corresponds well with the SEM image of the device.

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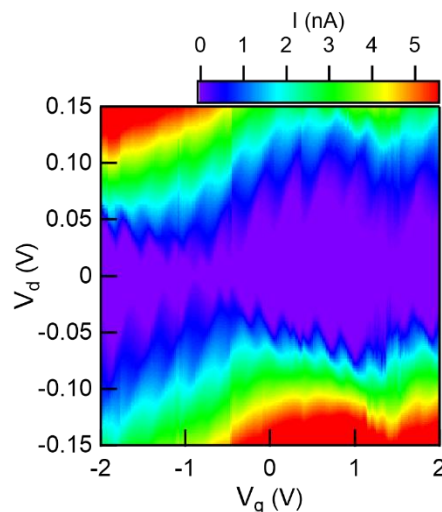


Fig.1 Schematic diagram of the COPV2/Au nanoparticle/COPV2 based triple-dot single-electron transistors

References

- [1] S. Kubatkin, et al., *Nature* **425**, 698 (2003).
- [2] S. J. Lee, J. Kim, T. Tsuda, R. Takano, R. Shintani, K. Nozaki and Y. Majima, *Appl. Phys. Express* **12**, 125007 (2019).
- [3] Y. Y. Choi, A. Kwon and Y. Majima, *Appl. Phys. Express* **12**, 125003 (2019).
- [4] R. Yu, R. Toyama and Y. Majima, *The 68th JSAP Spring Meeting*, 19a-Z16-1 (2021).