InP@ZnS Quantum Dot Single-Electron Transistor Memory

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Single Electron Transistors (SETs) have strong potential for next generation nano-electronic devices owing to their novel characteristics such as small size, low power consumption, high speed operation, single-electron sensitivity and adoption of multi-gate logic circuits. Generally, these SETs have been fabricated by using the critical dimensional Au nanogap electrodes with sub-10nm scale and Au nanoparticle as Coulomb island [1, 2]. However, Au nanogap electrodes have problems in the fine electrode patterning due to low annealing stability [1]. In this point of view, Pt is a good candidate electrode material for robustness and fine patterning.

Moreover, new type of nanoparticles instead of metal nanoparticles have been required to be considered as Coulomb island for the unique electrical characteristics. Quantum dot (QD) should be one of the interesting candidate materials for nanoparticles as Coulomb islands because of their small size less than 10nm and their bandgap tunability with simply QD size control.

Here we introduce Pt-based nanogap electrodes for the robustness and fine electrode patterning, and also InP@ZnS QD for novel characteristics as Coulomb island. The Pt-based nanogap electrodes were fabricated by the combination of electron beam lithography (EBL) and electroless Au plating (ELGP). InP@ZnS core-shell QDs were synthesized by techniques of colloidal chemistry. Combining the Pt-based Au nanogap electrodes and InP@ZnS QD, the chemically assembled InP@ZnS QD SETs were fabricated and exhibited the stable memory characteristics as shown in Fig.1.

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[1] V. M. Serdio V., Y. Majima et al., *Nanoscale*, **4**, 7161 (2012).
[2] V. M. Serdio V., Y. Majima et al., *RSC Adv.*, **5**, 22160 (2015).

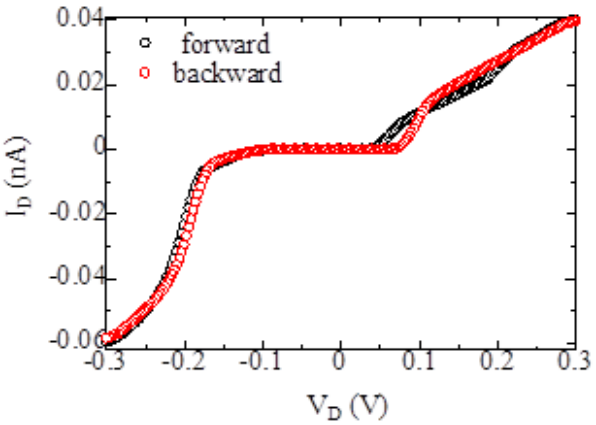

Figure 1. I-V characteristic of chemically assembled InP@ZnS QD SET at 9K