Negative Differential Conductance on Au_{25} Nanocluster Single-Electron Transistor

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Currently, single-electron transistors (SETs) considered as one of the candidates of next-generation transistors, since SETs have advantages for low power consumption and multi-logic circuits. Here, we report single-electron transistors (SETs) based on the Au_{25} cluster as Coulomb island toward a stable room temperature operation. Au_{25} cluster consists of icosahedral Au_{13} core as well as distinct bonding arrangement named "extend motif" (-S-Au-S-Au-S-) at the gold-thiolate interface [1], and the core diameter of Au_{25} cluster is only 1.2 nm. We synthesized Au_{25} nanocluster with 18 ligand molecules of 16 phenylethanethiol (PET) and 2 acetylthio-bipheny-thiol. For the Au_{25} cluster SET fabrication, we have fabricated ultra-fine hemispheric electroless gold plated (H-ELGP) Pt-based nanogap electrodes. The Au_{25} cluster has been chemisorbed between H-ELGP Pt-based nanogap electrodes from its solution. Clear gate voltage dependence of the I_d-V_d and dI_d/dV_d-V_d characteristics on single Au_{25} cluster SET was obtained in Figure 1(a). Negative differential conductance (NDC) were observed as negative dI_d/dV_d peaks at positive V_d. Experimental stability diagrams as function of V_d and V_g with the color maps of dI_d/dV_d also clearly showed gate voltage dependence. NDR peak voltage move as lines parallel to the borderlines of the diamonds in the regions where the current is not blocked at positive V_d.

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[1] M. Zhu et al, *J. Am. Chem. Soc*. **130** 5883 (2008)

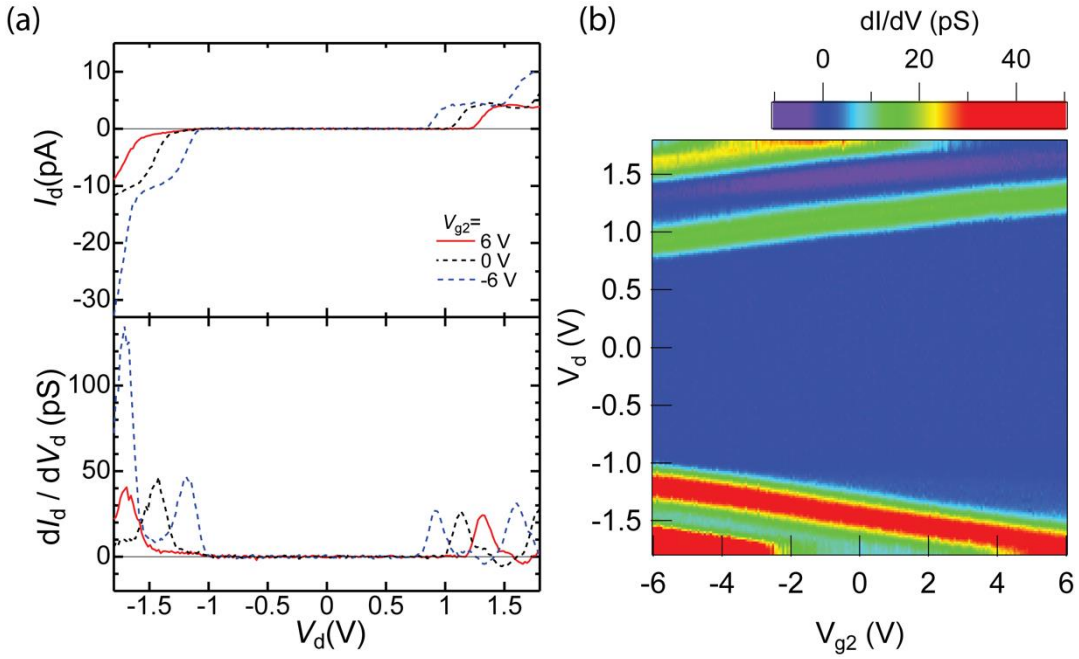

Figure 1. (a) I_d-V_d and dI_d/dV_d-V_d characteristics of Au_{25} nanocluster single-electron transistor (SET), (b) Experimental stability diagrams as function of V_d and V_g with the color maps of dI_d/dV_d. Both measurements are carried out at T = 9K.