

Optimization of Pt thickness for heteroepitaxial spherical Au/Pt nanogap electrodes

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The improvement of the transfer characteristics is crucial to meet the practical requirements of the single molecular transistors (SMT).^[1] Recently, we have reported the fabrication methods of heteroepitaxial spherical (HS-) Au/Pt nanogap electrodes with the top-particles radii of 5 nm based on ultra-fine Pt-based nanogap electrodes with a linewidth of 10 nm and well-defined Au spheres^[2, 3]. In the case of SMT based on HS-Au/Pt nanogap electrodes, HS-Au grown on the top of between the source and drain nanogap electrodes.^[2-5] An arrangement of a pair of heteroepitaxial Au spheres at the nanogap is essential for improving the transfer characteristics.^[2-5]

Here, we demonstrate that the optimization of Pt initial electrodes as follows. First, the nanogap electrodes' pattern was directly drawn on an EBL resist-coated SiO₂/Si substrate by using EBL apparatus (Elionix, ELS-7500EX). Then EBL resist development was applied, after which Ti as the adhesion layer and Pt with the thin and thick thickness were deposited on one substrate via e-beam deposition technique. The ultra-fine Pt-based nanogap electrodes with different Pt deposited thickness were obtained after a lift-off process. Finally, we employed electroless gold plating (ELGP) on the Pt-based nanogap electrodes to form HS-Au/Pt nanogap electrodes. By comparing the SEM images of HS-Au/Pt nanogap electrodes, we discuss the optimization of arrangement of HS-Au/Pt nanogap electrodes.

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