Expanding Micelle Nanolithography to the Self-Assembly of Multicomponent Core-Shell Nanoparticles

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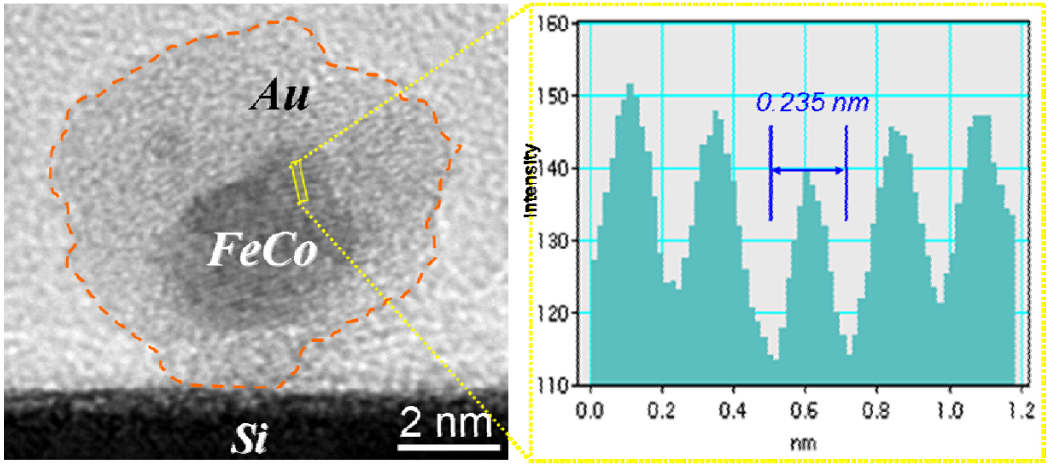
Supporting Information

TEM Methods

High-resolution transmission electron microscopy (HRTEM) was performed using a JEOL 4000EX (JEOL, Tokyo, Japan) transmission electron microscope operated at 400 kV. The interpretable resolution defined by the contrast transfer function of the objective lens is 0.16 nm. Due to a slight deviation of the eucentric height during observation, an estimated system error of 3% at most was expected for measuring the lattice spacings of target materials. Elemental mapping was performed using the Sub-eV-Sub-Ångtrom-Microscope (SESAM) (Carl Zeiss, Oberkochen, Germany) operated at 200 kV. An energy-selecting slit of 5 eV width was used to map the chemical distribution of Au and Fe-Co at energy-losses of 85 and 60 eV for the Au-$N_{6,7}$ and Fe-Co $M_{2,3}$ edges, respectively. Considering the acquisition geometry and inelastic delocalization, which involves mainly a collection semi-angle of 6 mrad with an energy window of 5 eV at an energy-loss beyond 60 eV, the spatial resolution of the elemental mapping is estimated to be less than 1 nm. The displayed elemental mapping shown in Fig. 2(d) was constructed in a R(red)-G(green)-B(blue) fashion, the component of which was derived by division of the zero-loss-filtered bright-field image from those acquired at specific energy-losses. The diffraction contrast can be thus minimized resulting in a solo imaging of the chemical characteristics.

Cross-section view of core-shell nanoparticles on a SiO_x/Si substrate



High-resolution transmission electron micrograph was acquired to obtain extensive information on the architecture of the FeCo@Au NP system with respect to the substrate. In particular, the coverage of the Au shell around the FeCo core. The HRTEM image reveals a core region which is arbitrarily orientated away from the major zone-axis so that the {111}-plane lattice fringes of the Au shell with a spacing of 0.235 nm are readily visible. The core also appears darker than the shell as observed from other FeCo@Au NPs prepared on Si_3N_4 TEM grids. The polycrystalline Au shell (marked by the orange dotted line) is seen to surround the FeCo core. thereby, forming core-shell architecture.