Supporting Information

Highly Crystalline Anisotropic Superstructures via Magnetic Field Induced Nanoparticle Assembly

Jong-Il Park, Young-wook Jun, Jin-sil Choi, and Jinwoo Cheon *

Department of Chemistry, Yonsei University, Seoul 120-749, Korea.

Small angle X-ray diffraction analysis of supercrystal rods (0.9 x 4.0 μm^2).

Two major peaks at 2θ = 0.99° and 1.92°, which correspond interplanar spacings of 10.3 nm and 5.4 nm, are indexed as $[111]_{SL}$ and $[311]_{SL}$ reflections of fcc-packed Co nanoparticle supercrystals rod. Other peaks at higher angles are not well-resolved but reasonably match with reflections of fcc-Co lattices with a lattice parameter of 17.8 nm.

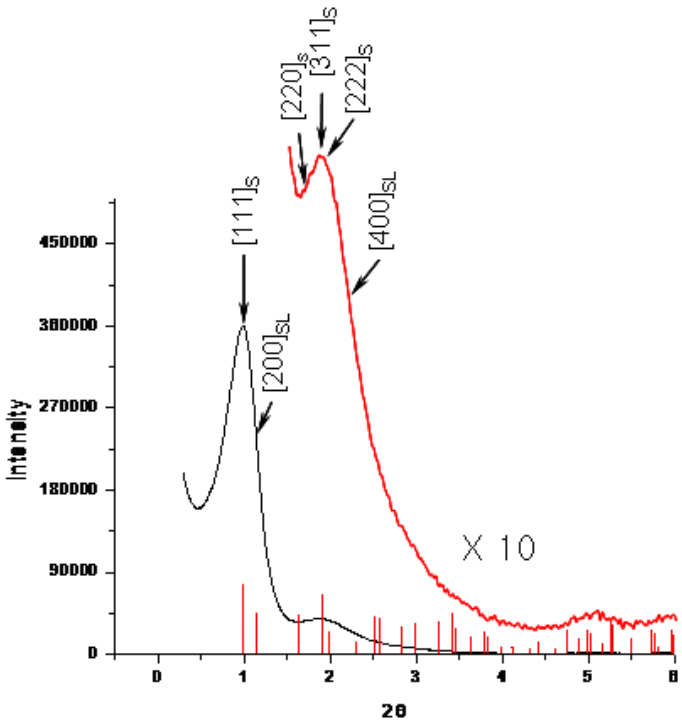

Figure S1. Small angle X-ray diffraction patterns of (a) supercrystal rods (0.9 x 4.0 μm^2). Red vertical lines are expected reflections of fcc-packed Co supercrystals with a lattice parameter of 17.8 nm.

Magnetic properties of supercrystal rods and wires

In the SQUID measurement, both superstructure rod and wire showed higher coercivity in their elongated directions. Rods showed increased coercivity with the perpendicular external field (6400 Oe) compared to that with the parallel field (Hc = 5800 Oe). Similiary, in case of wires, they had a larger coercivity value (Hc = 6700 Oe) in parallel external field than that of the perpendicular field (Hc = 5850 Oe). Co supercrystal wires had a larger coercivity value (H c= 6700 Oe) than that of rods (Hc = 6400 Oe) due to their long range coupled ordering and high anisotropic structures.

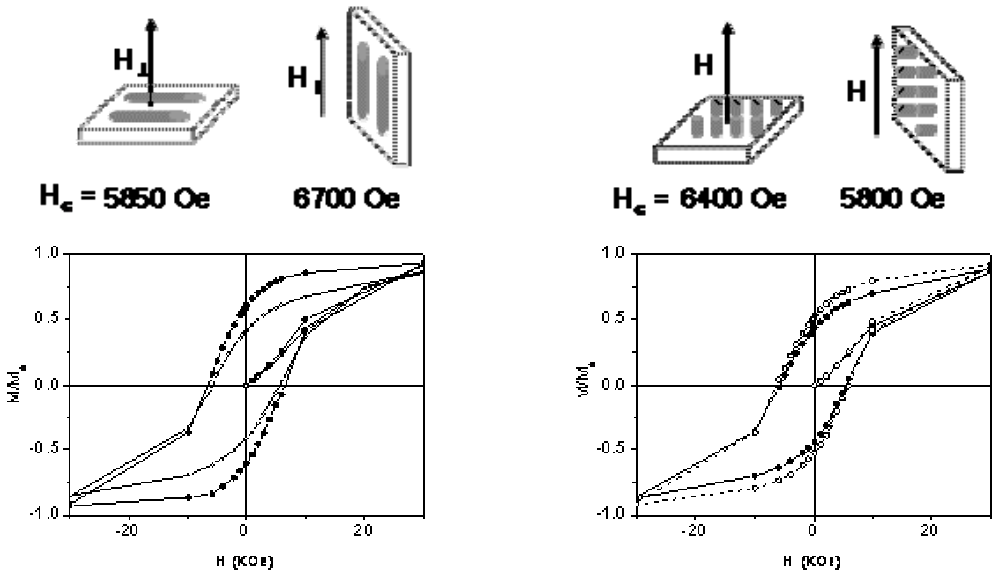

Figure S2. Hysteresis loops of Co supercrystal rods and wires. a) The measured field is parallel (- ●-) or perpendicular (-○-) to the substrate of Co supercrystal wires b) the measured field is parallel (-●-) or perpendicular (-○-) to the substrate of Co supercrystal rods.

Dipolar coupling of nanoparticles

Under the external magnetic field, magnetic nanoparticles are coupled by dipolar interaction. In high resolution TEM (HRTEM) image, Co nanoparticles are assembled with (111) lattice oriented along the external field, which is magnetically easy axis of fcc structured Co nanoparticle nanoparticle. This dipolar coupling of magnetic nanoparticles lead significant increase of coercivity because the dipolar interaction prohibits the flipping of spins.

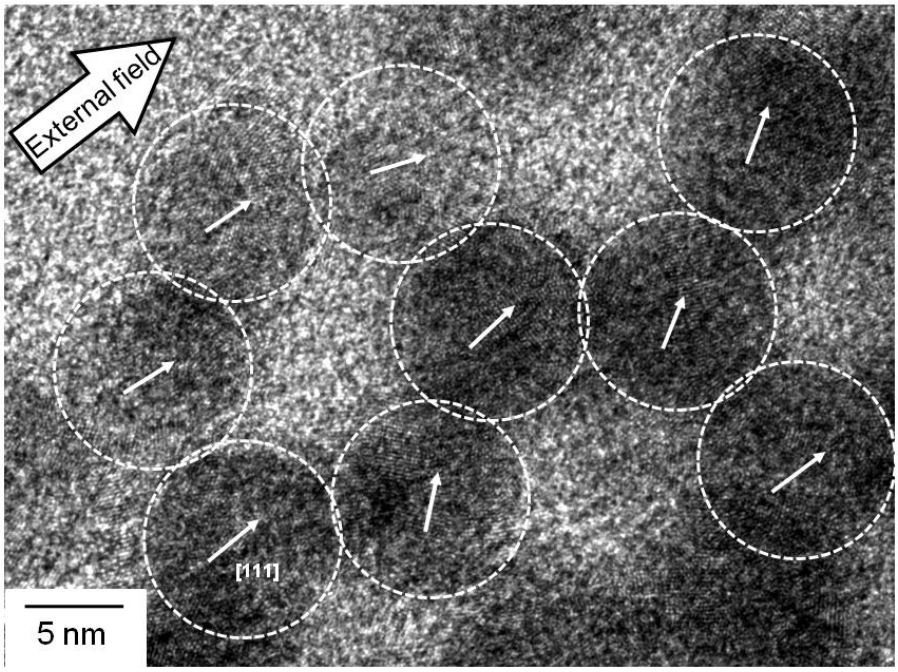

Figure S3. HRTEM image of ordered Co nanoparticle in supercrystal wires. Arrows represent the (111) lattice orientation of Co nanoparticles.