ORGANIC SOLVOTHERMAL SYNTHESIS OF NOBLE METAL BASED NANOMATERIALS WITH MORPHOLOGY CONTROL

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INTRODUCTION

Organic solvothermal synthesis has been demonstrated to be a robust way of preparing various nanomaterials (1-3). Typically, in an organic solvent, precursors (usually metal salts) are dissolved in the presence of surfactants (ligands), and decomposed (or reduced, by adding reducing agents) when heating up. When the concentration of precursor species comes to over saturation, nucleation starts and grows into nanocrystals. With the tenability of the growth conditions, like precursor, surfactant, temperature and solvent, the size and morphology of nanocrystals can be well defined and controlled. Here we apply this method for synthesizing noble metal (NM, including Pt, Pd, Au, Ag and their alloy) based nanomaterials. Morphology control is achieved for both zero dimensional (nanowire) and one dimensional (nanoparticle) nanomaterials. For example, Pt nanoparticles were made in cubic, cubo-octahedral and polyhedral shapes (Figure 1), and Au, FePt nanowires were prepared with diameter controlled below 10 nm (Figure 2). Moreover, composite nanoparticles can also be prepared with one particle epitaxially conjugated with another. In this case, two examples including NM-Fe_3O_4 and NM-NM nanoparticles are presented.

These nanoparticles show great potential in catalytic, electronic and biomedical applications. Several examples are presented as primary demonstrations. We have applied Pt based nanoparticles for fuel cell catalysis, Au-Fe3O4 nanoparticles for biomedical imaging (Figure 3), Au nanowires as interconnector for nanocircuits, respectively. More application work is still needed to be developed and some of them are under the way.

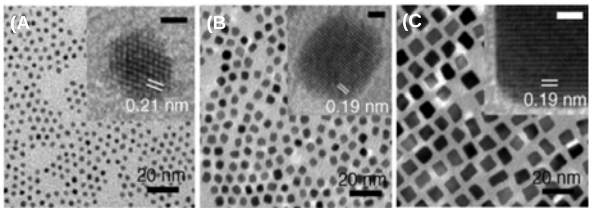

Figure 1. Representative TEM images of (A) the 3 nm polyhedral (B) the 5 nm truncated cubic and (C) the 7 nm cubic Pt NPs. The insets are the representative HRTEM images of corresponding single particles, showing (A) Pt(111), (B) Pt(100), and (C) Pt(100) lattice fringes. All scale bars in the insets correspond to 1 nm. (4)

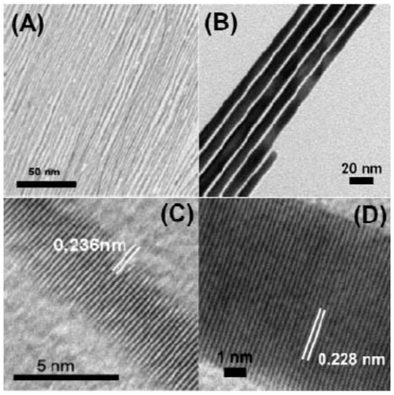

Figure.2 TEM images of (A) the 3 nm Au NWs, (B) the 9 nm Au NWs, and HRTEM images of (C) a 3 nm NW, (D) a 9 nm Au NW. (5)

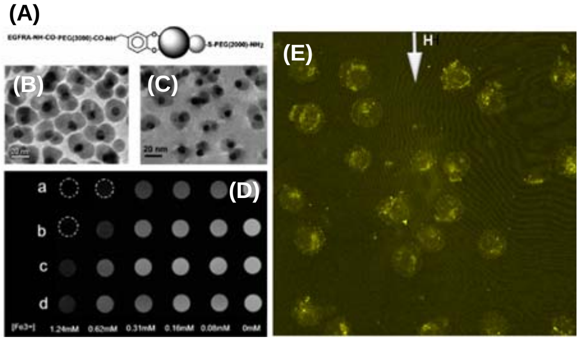

Figure 3. (A) Schematic illustration of the surface modification of Au-Fe3O4 nanoparticles for bio-imaging. TEM images of the Au-Fe3O4 nanoparticles (B) before and (C) after surface modification. (D) MRI contrast imaging of A431 cells labeled with Au–Fe3O4 nanoparticles. (E) Optical reflection imaging of the A431 cells labeled with Au-Fe3O4 nanoparticles and their movement under external magnetic field. (6)

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