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Phase and Heterostructure Controlled Fabrication of Freestanding Magnetic Nanocrystals[1]

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Magnetism at the nanoscale is still not fully understood. One of the major issues involved is the lack of precise experimental results. For nanoparticles, as their size shrinks the importance of surface atoms increases to such a level that they may dominate the overall magnetic performance. Clean and well defined surfaces on nanocrystals are therefore desirable to understand the surface effect with sufficient accuracy. Unfortunately, conventional fabrication techniques usually require specific surfactants or surface passivation agents, which may conceal the role of surface atoms. Here we report a unique technique that can prepare freestanding nanocrystals with controlled crystalline phase as well as desirous heterostructures. As an example, uniform $L1_0$ FePt nanoparticles with room temperature coercivity of 8.25 kOe were achieved. HRTEM analysis shows that these particles have perfect octahedron shape with only {111} surfaces exposed UHV compatible gas phase aggregation technique was used for the generation of nanoparticles. Atoms were generated from metal targets by using a magnetron sputtering gun, in which the plasma can be manipulated to provide certain circumstances for particle nucleation and growth. The materials were carried on by carrier gas from source to substrate so the nucleation and growth stages were separated in space. Monodispersity is therefore achieved together with controlled phase and structure.

[1]INSIC NIST-ATP Program;