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SYNTHESIS OF a-FE NANOPARTICLES BY MICROWAVE PLASMA

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Magnetic properties of iron-based materials can be highly enhanced if particles in the nanometer size are prepared. Therefore we investigated the possibilities of iron based nanopowder synthesis. The nanocrystalline iron-based powder has been prepared by microwave plasma method. Iron pentacarbonyl $Fe(CO)_5$ vapour was introduced into a low pressure (500 Pa) argon discharge. A microwave 2.45 GHz generator was operated at 430 W. The reaction took place inside a quartz tube passing through a microwave waveguide. During the synthesis process, optical emission spectroscopy was carried out. The synthesized nanopowder was then passivated in-situ with air. The as-prepared nanopowder was then characterized by transmission electron microscopy (TEM), X-ray diffraction (XRD) and by Mössbauer spectroscopy. According to our TEM investigation (see Figure 1), the produced passivated powder includes core-shell nanoparticles. The cores consist of a-Fe and the shell is iron oxide (indicated by dark field TEM). The presence of a-Fe and iron oxides was also confirmed by XRD and Mössbauer spectroscopy. The mean particle size of a-Fe cores was 30 nm. The synthesized nanopowder exhibited ferromagnetic behaviour.

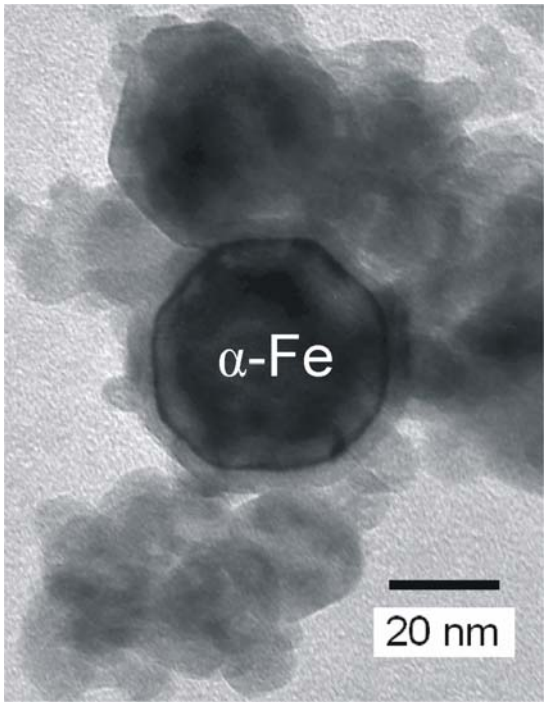

Figure 1: TEM image of a polyhedral Fe particle with an iron-oxide shell

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