

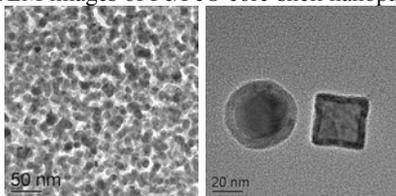
## Iron-iron oxide core shell nanoparticles for contaminant underground water treatment

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Metallic iron chemically reduces contaminants such as chlorinated hydrocarbons for underground water cleanup. The use of nano-sized particles of iron is of interest because of enhanced possibilities for distribution, a high rate of reactivity and the possibility enhancing environmentally friendly reaction paths. An oxide shell or other protective layer plays an important role along with the metallic iron core in chemical reactions. Examination of the chemical properties of monodispersed metallic iron nanoparticles with a well-defined clean oxide shells is important to understand the chemistry of nanoparticles. However, production of these particles by conventional methods is difficult. Therefore, we are using a cluster deposition system, which prepare the iron nanoparticles and iron-iron oxide core shell nanoparticles at room temperature by a method that is a combination of high-pressure sputtering and aggregation techniques. The outer oxide layer acts as a passivation layer of these particles, preventing further oxidation of the cores upon continued exposure to the atmosphere. Size of the iron-iron oxide core-shell nanoparticles can be varied with the rate of He and Ar gas flow, the chamber pressure, the sputtering power and the growth distance. These films are characterized by XPS, XRD, HRTEM and voltametry measurements.

Fig. 1 TEM images of Fe/FeO core-shell nanoparticles



## References

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## Thermodynamics of high temperature iron oxide nanoparticles obtained by laser pyrolysis

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Pure and uniform  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> nanoparticles particles between 2 and 15 nm have been prepared at high temperature by a continuous process based on ethylene sensitised laser pyrolysis of gaseous Fe(CO)<sub>5</sub> in an oxidizing atmosphere, suggesting that  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>, rather than  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>, is the thermodynamically stable phase for ultra small iron oxide particles.

The samples were characterised by X-ray diffraction (XRD), transmission electron microscopy (TEM), Brunauer-Emmet-Teller gas adsorption (BET), thermogravimetric analysis (TG), elemental analysis and Mössbauer spectroscopy. The thermodynamic properties of the iron oxide samples were determined by transposed temperature drop calorimetry and high temperature drop solution calorimetry using sodium molybdate solvent at 700° C.

The crystal structure of the iron oxide ultra fine particles potentially depends not only on the particle size, but also on the thermal history of the particle formation. In order to explore the effect of the thermal history of the particles, the thermodynamic properties of the obtained materials were compared with the properties of  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub> nanoparticles obtained by chemical solution techniques.