NANO HIGHLIGHT
Synthesis and Classification of Monodisperse Magnetic Nanoparticles

NSF NIRT Grant 0304649
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Magnetic nanoparticles/nano-composites (ferromagnetic, ferrimagnetic and antiferromagnetic materials) have many promising industrial and biomedical applications such as catalysis, magnetocooling, optical and recording devices, purification of enzymes and other biological materials, and water purification devices.

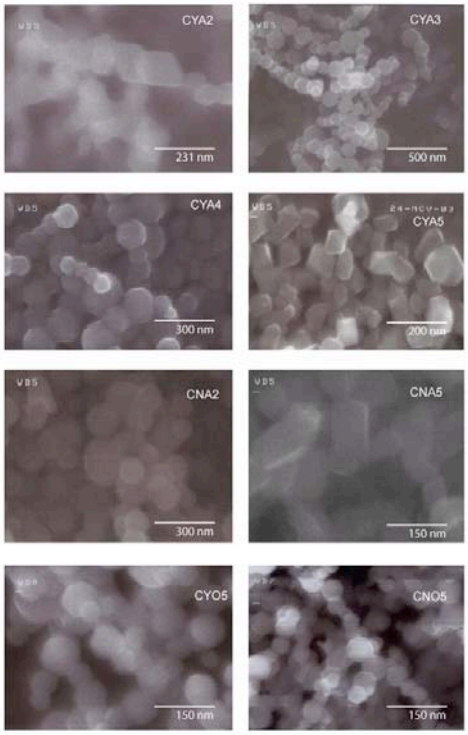

Figure 1 shows EM images of synthesized γ- phase nanoparticles at different operation conditions of aerosol flame reactor

Most of the conventional methods for the synthesis of magnetic nanoparticles are rather complex, usually involving several steps; efforts have been made to establish direct preparation routes of these magnetic particles. In this project, γ-phase iron oxide nanoparticles were synthesized using a flame aerosol reactor. The effects of flame temperature profile and sampling conditions have been investigated on the morphology and magnetic properties of synthesized maghemite nanoparticles. The particle size and magnetic properties of the powders can be controlled by varying the flame temperature and sampling conditions. Figure 1 shows the EM images of synthesized γ-phase iron oxide naoparticles under different flame conditions. To obtain mono-sized magnetic nanoparticles for a variety of industrial and medical applications, a high-throughput monodisperse particle classification system capable of tailoring synthesized nanoparticles into tighter size distributions has been designed and fabricated. The system consists of a high-throughput, high-charging-efficiency nanoparticle charger [1] and a high throughput nanometer differential mobility analyzer [2]. The system performance had been evaluated prior to its integration with the flame synthesis system. Besides the development of the classification system, the effort has been also on the development of a multi-stage differential mobility analyzer column [3]. This new DMA column allows the multiple extractions of mono-sized nanoparticles simultaneously. The new column expects to facilitate the classification and testing processes while reducing the waste of synthesized magnetic nanoparticles.

References

[1] D. Chen and David Y. H. Pui, "A High Efficiency, High Throughput Unipolar Aerosol Charger for Nanoparticles", J. of Nanoparticle Research, 1, p115-126, 1999.
[2] D. Chen, David Y.H. Pui, D. Hummes, H. Fissan, F.R. Quant and G.J. Sem, "Design and Evaluation of a Nanometer Aerosol Differential Mobility Analyzer (Nano-DMA)," Journal of Aerosol Science, 29, pp. 497-509, 1998.
[3] Weiling Li, D. Chen, and M. Cheng, "Development of a Multiple-stage DMA," 23rd annual AAAR conference, Atlanta, Georgia, Oct. 4-8, 2004.
[4] For further information on the project please email chen@me.wustl.edu.