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Tuning the magnetic performance of hexaferrite magnets via nanostructuring

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As modern-day functional materials become more and more complex, an increasingly detailed understanding of the structural features governing their physical properties is necessary in order to understand and improve their macroscopic performance. In the case of permanent magnets, the complex interplay between atomic-, nano- and micro-structural features such as composition, crystallite size, morphology, relative crystallite arrangement, density, *etc.*, determines the magnet's macroscopic performance. We have developed a bottom-up nanostructuring protocol for preparation of high-performance strontium hexaferrite permanent magnets.[1] Phase pure, highly crystalline $SrFe_{12}O_{19}$ nanoparticles of various sizes and morphologies have been produced by different synthesis methods and by variation of specific reaction parameters. The tailor-made nanopowders have subsequently been compacted to form highly dense magnets (>90% of the theoretical density) by spark plasma sintering (SPS). Meticulous structural analysis by combined Rietveld refinement of neutron and X-ray powder diffraction data reveal a clear correlation between crystallite size and long-range magnetic order, which, in turn, influences the magnetic properties of the nanocrystallites. Furthermore, the results obtained from Rietveld analysis of powder diffraction data, texture analysis via X-ray and neutron pole figures and magnetic property measurements, reveal a direct correlation between nanoparticle morphology, self-induced texture, crystallite growth during compaction and macroscopic magnetic performance of the consolidated magnets.[2,3] Consequently, magnetically aligned, highly dense magnets with record-high energy product for dry-processed ferrites are obtained by bottom-up nanostructuring means, without application of an external magnetic field before or during compaction.

[1]. Saura-Múzquiz M., Granados-Miralles C., Stingaciu M., Bojesen E. D., Li Q., Song J., Dong M., Eikeland E. and Christensen M., *Nanoscale*, 2016, 8, 2857-2866.
[2]. Eikeland A. Z., Stingaciu M., Mamakhel A. H., Saura-Múzquiz M. and Christensen M., *Sci Rep*, 2018, 8, 7325.
[3]. Saura-Múzquiz M., Granados-Miralles C., Andersen H. L., Stingaciu M., Avdeev M. and Christensen M., *ACS Appl Nano Mater*, 2018, 1, 6938-6949.

Speakers Gender

Female

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No

Level of Expertise

Early Career <5 Years since PdD

Do yo wish to take part in the poster slam

No

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