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Electrochemical Deposition of Three Dimensional Magnetic Mesocrystals

F. Nasirpouri[1,3]*, M.A. Engbarth[1], A. Müller[1], S.J. Bending[1], and L.M. Peter[2]

[1]Department of Physics, University of Bath, Bath BA2 7AY, UK

[2]Department of Chemistry, University of Bath, Bath BA2 7AY, UK

[3]Department of Materials Engineering, Sahand University of Technology, Tabriz, Iran (Present address)

*Corresponding author: Farzad Nasirpouri, Email: f_nasirpouri@yahoo.com or f.nasirpouri@bath.ac.uk

Realising new magnetic materials and structures is key to the search for novel magnetic properties which can be exploited in applications. Over the last few years considerable progress has been made in developing artificially architectured magnetic nanostructures, which are generally made using complex and costly nanofabrication techniques. Exploiting the ability of materials to self-organise into well-defined structures is also a very active area of study due to the greater flexibility and lower cost of this approach. Electrodeposition is one such high-throughput synthesis method which has been widely used to realise structures with novel magnetic properties. Indeed, under specific deposition conditions, one can manipulate the size and the shape of the electrodeposited centres and systematically tune their magnetic properties. Recent results [1,2] show that metallic structures, such as nanowires, polyhedra and much more complex fractal-like structures, can be fabricated by electrodeposition. At the same time the magnetic properties of *individual* mesostructures can now be investigated using advanced ultra-sensitive measurement techniques like Hall probe array nanomagnetometry [3]. We here report the realisation of nickel mesostructures and core-shell samples with different shapes (e.g., nanowires, granular particles, and highly faceted microcrystals) by electrodeposition from aqueous solutions on highly oriented pyrolytic graphite (HOPG). Hall probe magnetometry of single mesocrystals reveals well-resolved structures that reflect the shape and geometry of the samples in this size regime.

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REFERENCES

[1] M.P. Zach *et al*., Science, **290** (2000) 2120.
[2] Z-L. Xiao *et al*., J. Am. Chem. Soc., **126** (2004) 2316.
[3] S.T. Stoddart *et al*., Phys. Rev. Lett., **71** (1993) 3854.

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A Magnetization Study of Prussian-blue Analogue $Na_xMn_y[Fe(CN)_6]$

Nguyen Van Minh[1]*, Phung Kim Phu[1], Nguyen Minh Thuan[1], Duong Manh Toan[1], and In-Sang Yang[2]

[1]Center of Nano Science and Technology, Hanoi National University of Education, 136 Xuan-Thuy Rd., Hanoi, Vietnam

[2]Division of Nano-Sciences and Department of Physics, Ewha Womans University, Seoul 120-750, Korea

*Corresponding author: e-mail: minhsp@yahoo.com, yang@ewha.ac.kr

In this report, we investigate the effect of size of the particles on the properties of the Prussian blue analogue $Na_xMn_y[Fe(CN)_6]$. We present a novel synthesis method of the $Na_xMn_y[Fe(CN)_6]$ nano-particles. The results of the X-ray diffraction (XRD), scanning electron microscopy (SEM), magnetization measurements, and absorption spectroscopy studies of the compounds are investigated.

Two different kinds of samples are compared; one kind made using water solvent, hereafter called sample A, and the other kind using formamide solvent, called sample B. SEM images show that the $Na_xMn_y[Fe(CN)_6]$ particles of sample A are in cubic shape with the average sizes of about 2 μm, whereas the size of the particles of sample B is about 100-150 nm. This indicated that the formamide solvent has prevented the particle size from growing.

Fig. 1 shows the zero-field-cooled (ZFC) and field-cooled (FC) magnetization curves in the range of 2-50 K obtained for the $Na_xMn_y[Fe(CN)_6]$ samples. Fig. 1(a) corresponds to sample At, and Fig. 1(b) to sample B, respectively. The FC and ZFC curves of sample A overlap each other (Fig. 1a), meaning that the magnetic property is similar to the bulk sample. On the other hand, the ZFC curve of sample B shows a narrow peak at 11 K, which indicates the blocking temperature (T_B) of the nanoparticles with a mean volume. As shown in Fig. 1(b), there is a divergence between the field cooled (FC) and the zero field cooled (ZFC) magnetization curves at 11 K, well below the Currie temperature. This indicates that the nanoparticles are single domain superparamagnets with a blocking temperature of 11 K, at which there is a local maximum in the ZFC curve. The increase in the FC values with decreasing temperatures and the local maximum peak in the ZFC magnetization are indications of cluster spin-glass behavior.

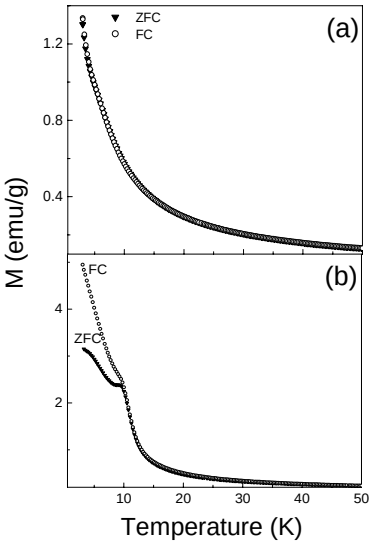

Fig. 1.