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1st International Symposium on Nanoparticles/Nanomaterial and Applications

20th – 22nd January 2014
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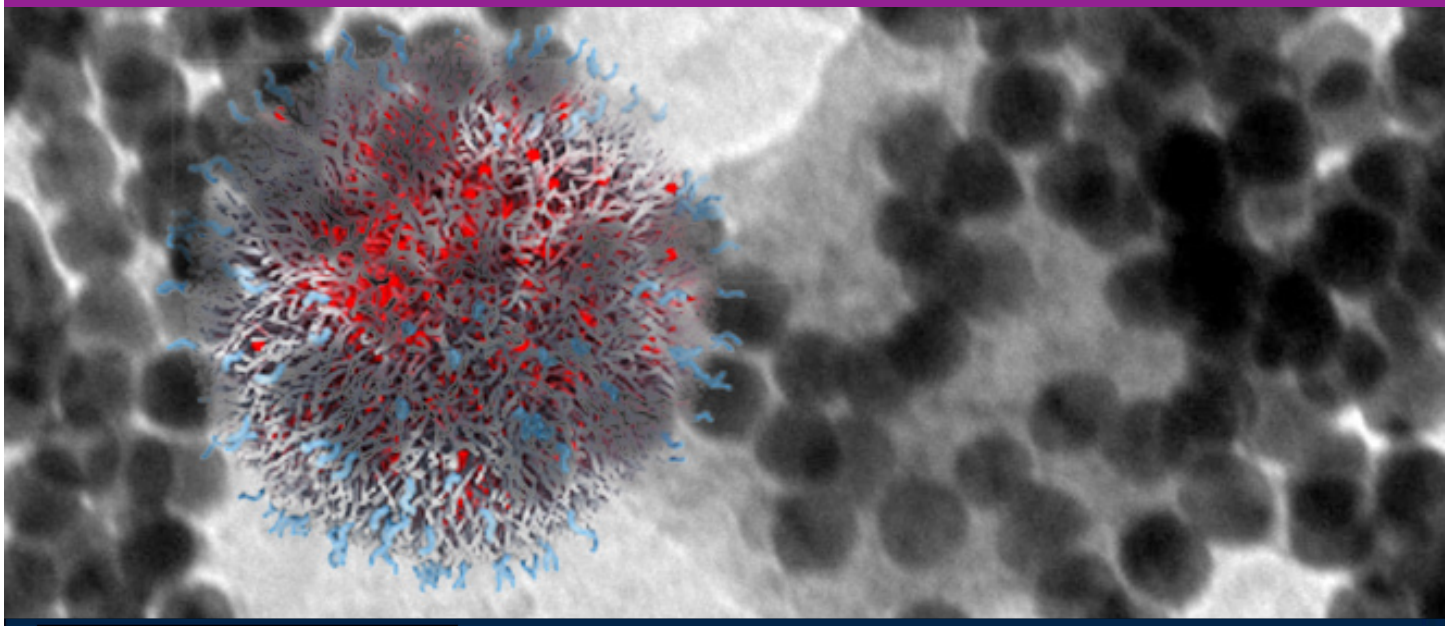

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Proceedings of the 1st ISN2A, 1st International Symposium on Nanoparticles/ Nanomaterials and Applications

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SG11B- Tailoring Size & Composition In Manganese Ferrite Nanoparticles To Enhance Magnetization

Kosmas Vamvakidis[1], Melita Menelaou[1] , Despoina Sakellari[2], Catherine Dendrinou-Samara[1].

[1]Department of Chemistry, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece.

[2]Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece.

kvamvaki@chem.auth.gr

Abstract

Finite-size and surface effects in magnetic nanoparticles (MNPs) give rise to properties significantly different to the corresponding bulk materials. Superparamagnetic spinel ferrites nanoparticles MFe_2O_4 (M = Mn, Fe, Co, Ni) are currently considered among the most successful MNPs for medical applications [1], [2]. However, a well-known problem is the magnetization reduction emerging when their size decreases within the nanoscale regime, particularly for nanocrystals smaller than 20 nm, related to the larger percentage of atoms located on surface.

We have initiated studies [3] into manganese ferrite nanoparticles with enhanced magnetization focusing on their structural properties. A facile solvothermal approach was used to synthesize stable superparamagnetic manganese ferrite nanoparticles with relatively small sizes. By varying the oxidation state of manganese precursor, $Mn(acac)_2$ to $Mn(acac)_3$, different sizes, 8 and 5 nm, of $MnFe_2O_4$ nanoparticles were obtained respectively, while by tailoring the synthetic conditions iron-rich $Mn_{0.77}Fe_{2.23}O4$ nanoparticles have been isolated with identical sizes and enhanced saturation magnetization. The magnetization values increased from 58.2 to 68.3 Am^2/kg and from 53.3 to 60.2 Am^2/kg for the nanoparticles of 8 nm and 5 nm, respectively.

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Figure 1 (a),XRD patterns (JCPDS no. 10-0319), (b) SQUID measurements of the spinel nanoparticles

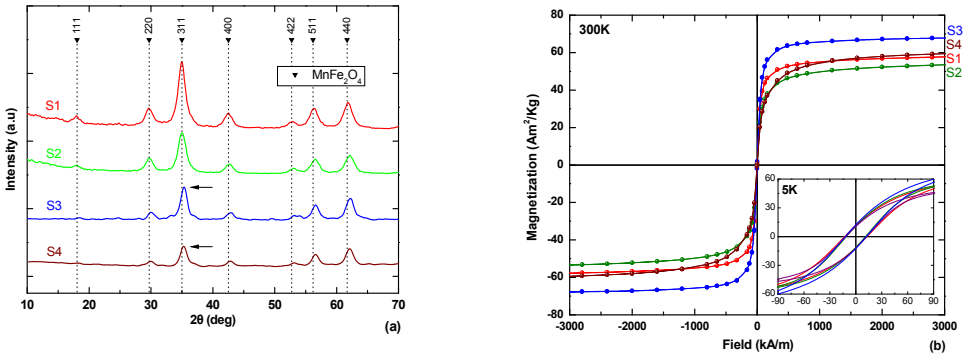

Table 1 Structural and magnetic properties of the nanoparticles

Sample	Phase	Size (nm)	300 K		T_B (K)	K_{eff} (10^5 J/m^3)
			M_S (Am^2/Kg)	H_C (kA/m)		
S1	$MnFe_2O_4$	8.0	58.2	0.5	120	1.5
S2	$MnFe_2O_4$	5.1	53.3	1.0	80	4.2
S3	$Mn_{0.77}Fe_{2.23}O_4$	8.2	68.3	0.7	180	2.5
S4	$Mn_{0.77}Fe_{2.23}O_4$	5.0	60.2	0.2	110	4.9