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New possibility in the characterization of nanomaterials with solid state NMR spectroscopy enhanced by dynamic nuclear polarization

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Solid-state NMR spectroscopy is the most powerful structural elucidation technique of powdered solids available and provides very detailed structural and dynamics information across both the physical and biological sciences. However, the weak sensitivity of the NMR signals poses major limitation, requiring many hours or days of acquisition time. This prevents the use of solid-state NMR for structure characterization in many areas, in particular the study of advanced functionalized nanomaterials. A powerful and really dramatic approach involves the use of electron as source of polarization to enhance the solid-state NMR signal by multiple orders of magnitude, a technique known as dynamic nuclear polarization (DNP). The talk will describe the use of stable radicals and transition metal high spins ions as the source of electrons, and recent breakthrough in the applications of DNP enhanced solid-state NMR spectroscopy towards the high-throughput structural characterization of a extremely large range of nanomaterials such as polymeric organic nanoporous materials, inorganic materials, hydrogels and metal organic frameworks.

Biography

Frederic Blanc received his PhD in Chemistry from the University of Lyon (France) in 2008 working on solid-state NMR methods to characterize surfaces and nanomaterials. He was then a Lavoisier postdoctoral fellow at the State University of New York in Stony Brook from 2008 to 2010 and a Marie Curie fellow at the University of Cambridge from 2010 to 2012, and recently joined the faculty of the University of Liverpool as an Assistant Professor/Lecturer in Chemistry. His research interests lie at the frontier of NMR spectroscopy and nanomaterials, and he has published more than 35 papers.

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Synthesis, characterization and FC-ZFC magnetization studies of cobalt substituted lithium nano ferrites

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Cobalt substituted lithium nano ferrites with the chemical composition [Li0.5Fe0.5]1- $xCoxFe_2O_4$ (where x=0.0, 0.2, 0.4, 0.6, 0.8, 1.0) were synthesized through one of the sol-gel process, Citrate-Gel auto combustion technique. Structural characterization of the prepared ferrites was carried by X-ray diffraction analysis and SEM. XRD analysis has confirmed the formation cubic spinel structure of the ferrite compositions with a particle size in the range of 37-42 nm. The SEM images represent large agglomeration of the nano particles of the ferrite samples where the distribution of the grain size is broad and not uniform. Temperature dependent magnetic properties of [Li0.5Fe0.5]1-$xCoxFe_2O_4$ for two compositions with cobalt content x=0.8 and x=1.0 was carried out using vibrating sample magnetometer (VSM). The magnetization as a function of an applied field ±10 T was carried out at temperatures 5 K and 310 K. Field cooled (FC) and Zero field cooled (ZFC) magnetization measurements under an applied field of 100 Oe and 1 KOe in the temperature range of 5 K to 375 K were performed. These measurements have resulted in blocking temperature (Tb) at around 350 K i.e. above room temperature for both the ferrites. Below this temperature the ferrites show ferromagnetic behavior and above which superparamagnetic behavior where the coercivity and remanence magnetization are almost zero. Such behavior makes the ferrites to be desirable for biomedical applications.

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