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RESEARCH
HIGHLIGHTS



EVENTS AND
MEETINGS TO BE
ANNOUNCED



OTHER NEWS NONE
FOR THE MOMENT

NEWSLETTER 2016



Dear Colleagues and friends,

I have been asked by the CNRS to be in charge of the French part of the Indian-French Laboratory of Solid State Chemistry. IFLaSC in English or LaFICS in French is an Associated International Laboratory created in 2003 between the **Centre National de la Recherche Scientifique (CNRS)**, a French public scientific and technological institution, the **Université de Caen Basse Normandie (UCBN)**, the **Université de Strasbourg, Alsace** public scientific and professional institutions and The **Indian Institute of Science, Bangalore (IISc)**, an autonomous public institution funded by the government of India. Several laboratories and institutions linked to the CNRS, the UCBN and the IISc are involved in this LaFICS that are:

- the Institut de Chimie de la Matière Condensée de Bordeaux (ICMCB)
- the Institut de Physique et Chimie des Matériaux de Strasbourg (IPCMS)
- the Laboratoire de Cristallographie et Science des Matériaux de Caen (CRISMAT)
- the Ecole Nationale Supérieure d'Ingénieurs de Caen
- the Université de Strasbourg
- The Solid State and Structural Chemistry Unit, SSCU, in Bangalore
- Materials Research Center (MRC), IISc, in Bangalore
- The Indian Institute of Technology, Bombay, India (IIT/B), through its Department of Metallurgical Engineering & Materials Science (MEMS)



- The Indian Institute of Technology, Madras, India (IIT/M), through its Department of Chemistry

With this News Letter I wish to bring some more dynamism to this LIA and encourage Indians and French Researches to promote excellent and fruitful collaborative projects.

In this News Letter you will then find some insights concerning the activities performed in the framework of this LIA.

Enjoy your reading!

Marie Helene DELVILLE, PhD

Research highlights

Solanki, V.; Lebedev, O. I.; Seikh, M. M.; Mahato, N. K.; Raveau, B.; Kundu, A. K., Synthesis and characterization of Co–Ni and Fe–Ni alloy nanoparticles. *Journal of Magnetism and Magnetic Materials* 2016, 420, 39-44. <http://www.sciencedirect.com/science/article/pii/S0304885316312823>
CRISMAT, France/IIIT Jabalpur, India

This article shows the study of magnetic alloy nanoparticles which have been synthesized by sol-gel method with a stable Pm-3m cubic structure. The Co–Ni and Fe–Ni alloy nanoparticles are highly crystalline and exhibit preferential low index $\langle 111 \rangle$ faceting as determined from HRTEM investigation. TEM images and EDX elemental mapping also confirm the nano-dimensional structure with core-shell structure, where the alloy forms the core and the shell is formed by amorphous carbon. The magnetization results of the alloy nanoparticles confirm the ferromagnetic nature at room temperature akin to their bulk metals with a significant value of field dependent isothermal magnetization at high temperature (390 K).

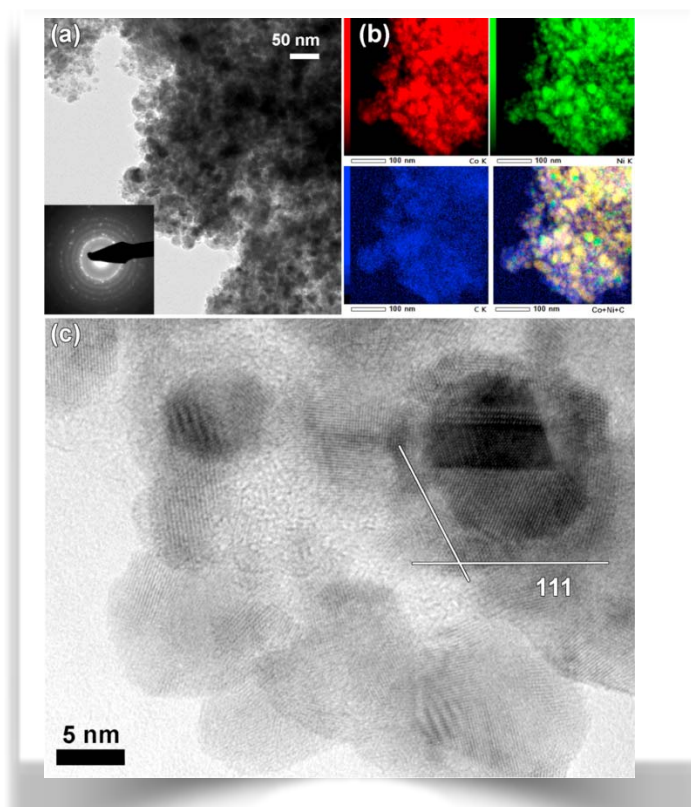


Figure (a) Bright field low resolution TEM images and corresponding ED rings, (b) EDX elemental mapping and (c) bright field HRTEM image of Co–Ni nanoparticles.

Seikh, M. M.; Kundu, A. K.; Caignaert, V.; Raveau, B., Gigantic effect of iron doping upon magnetism in the $\llcorner 114 \gg$ magnetoelectric $\text{CaBaCo}_4\text{O}_7$. *J. Alloys Compd.* 2016, 656, 166-171. http://ac.els-cdn.com/S0925838815309543/1-s2.0-S0925838815309543-main.pdf?_tid=cfa28820-3879-11e6-af35-00000aab0f27&acdnat=1466600830_a9717f75d3dc188ff7c6dc37b714e045
 CRISMAT, France/IIT Madras, India

The study of the $\text{CaBaCo}_4\text{-xFexO}_7$ oxide shows that a huge decrease of ferrimagnetism is produced for very low Fe contents ($x < 0.05$) at the benefit of magnetic phase sepn. and magnetic frustration. This gigantic effect of iron doping at the Co^{3+} sites in $\text{CaBaCo}_4\text{O}_7$ is compared to that produced by diamagnetic Ga^{3+} and Al^{3+} dopants, showing that the antiferromagnetic interactions between the dopant Fe^{3+} and the Co^{2+} ferromagnetic chains has a crucial role in the destabilization of the ferrimagnetic structure, whereas the triangular geometry of the cobalt sublattice imposes the appearance of magnetic frustration.

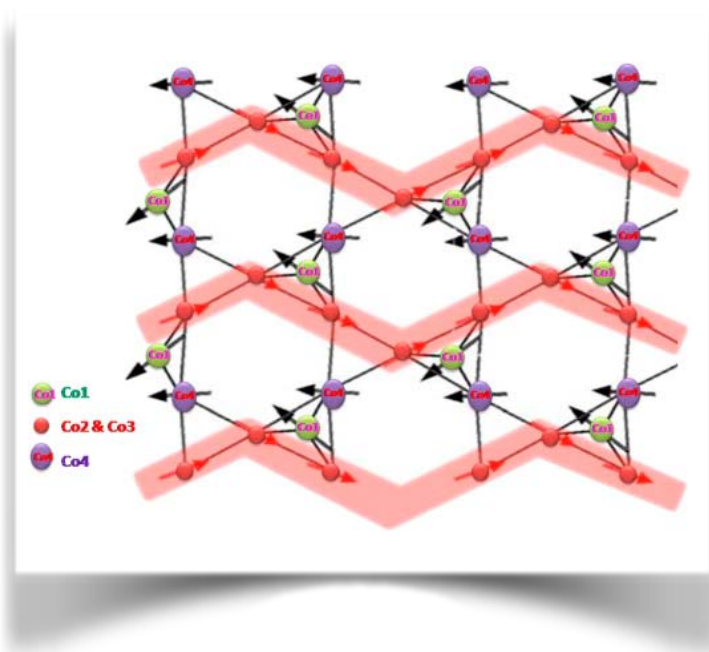
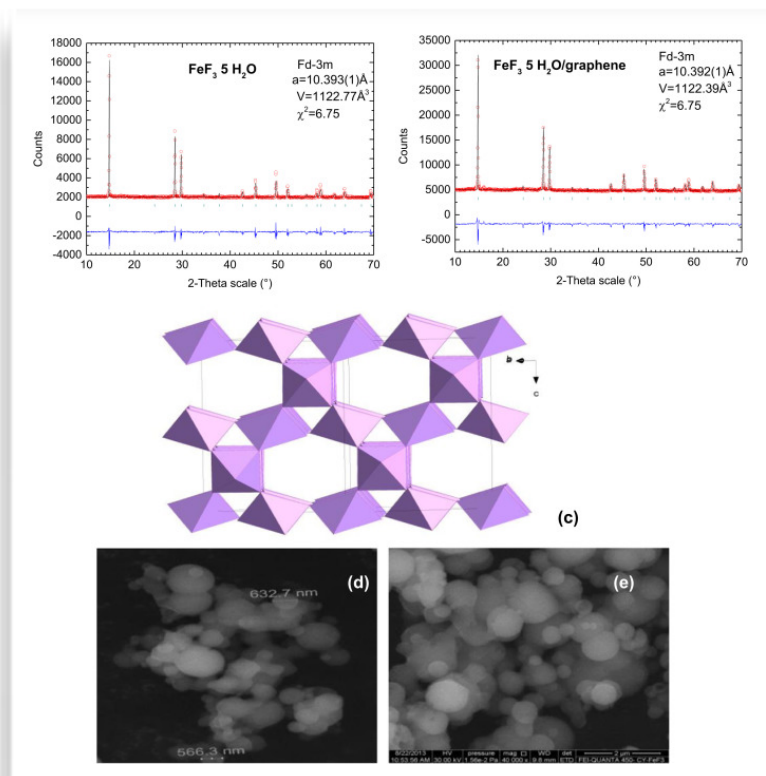


Figure: Magnetic structure of $\text{CaBaCo}_4\text{O}_7$ showing the Co^{2+} (red circle) zig-zag ferromagnetic chains (Brick red stripe). The Co^1 (green circle) and Co^4 (violet oval) are surrounded by the parallel zig-zag chains and coupled antiferromagnetically to the Co^{2+} chains. (For interpretation of the references to color in this figure legend, the reader is referred to the webversion of this article.)

Rao, R. S.; Pralong, V.; Varadaraju, U. V., Facile synthesis and lithium reversible insertion on iron hydrated trifluorides $\text{FeF}_3 \cdot 0.5\text{H}_2\text{O}$. *Mater. Lett.* 2016, 170, 130-134. http://ac.els-cdn.com/S0167577X16301719/1-s2.0-S0167577X16301719-main.pdf?_tid=e1a1b634-387b-11e6-be3f-00000aab0f02&acdnat=1466601719_10cab848b4131fd691fc847535573e6c
IIT Madras, India/CRISMAT, France

An original synthesis method for the synthesis of hydrated iron trifluorides is presented for the first time. This method, based on solvothermal process starting from iron salt and HF in alc., is economic, simple and environmentally benign. The electrochem. performances of the composite phase $\text{FeF}_3 \cdot 0.5\text{H}_2\text{O}/\text{graphene}$ shows enhanced capacity of 200 mAh/g at C/20.

Figure. (a) Reitveld refinement pattern of $\text{FeF}_3 \cdot 0.5\text{H}_2\text{O}$, Red dots and black lines are corresponds to observed and calculated patterns, the bottom curve is the difference of patterns, $y_{\text{obs}} - y_{\text{cal}}$. (b) Reitveld refinement pattern of $\text{FeF}_3 \cdot 0.5\text{H}_2\text{O}/\text{graphene}$ composite, red dots and black lines are corresponds to observed and calculated patterns, the bottom curve is the difference of patterns, $y_{\text{obs}} - y_{\text{cal}}$. Structural view of $\text{FeF}_3 \cdot 0.5\text{H}_2\text{O}$ along the a direction (c), SEM images of $\text{FeF}_3 \cdot 0.5\text{H}_2\text{O}$ (d) and its graphene composite (e). $\text{FeF}_3 \cdot 0.5\text{H}_2\text{O}$ and $\text{FeF}_3 \cdot 0.5\text{H}_2\text{O}/\text{graphene}$ composites show spherical morphology with less than 1 μm radius uniformly. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

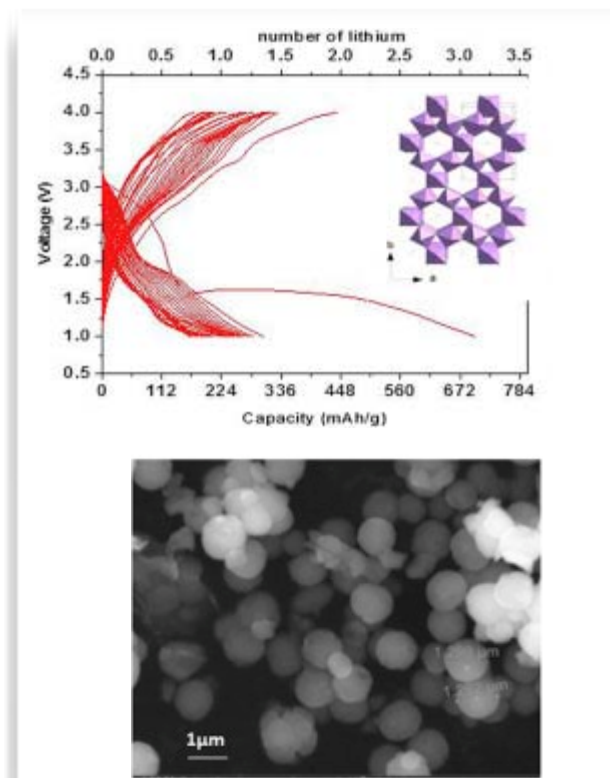


Kumar, V. P.; Guilmeau, E.; Raveau, B.; Caignaert, V.; Varadaraju, U. V., A new wide band gap thermoelectric quaternary selenide $\text{Cu}_2\text{MgSnSe}_4$. *Journal of Applied Physics* 2015, 118.

IITM India/CRISMAT, France

An original synthesis method for the synthesis of hydrated iron trifluoride is presented. This method, based on solvothermal process starting from iron salt and HF in alcohol, is economic and simple. The electrochem. performances of the composite phase $\text{FeF}_3 \cdot 0.33\text{H}_2\text{O}$ /Graphitic oxide is showing enhanced capacity of 250 mAh/g at 0.05 °C.

Figure. $\text{FeF}_3 \cdot 0.33\text{H}_2\text{O}/\text{rGO}$ composite: Galvanostatic charge-discharge cycling at 0.1 °C current rate vs. Li^+/Li and SEM images of $\text{FeF}_3 \cdot 0.33\text{H}_2\text{O}/\text{rGO}$



Behera, B. C.; Padhan, P.; Prellier, W., Effect of $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ crystal structures on magnetization of (1 1 1) oriented $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ - SrRuO_3 superlattices. *J Phys Condens Matter* 2016, 28, 196004. IIT Jabalpur, India/CRISMAT, France

A series of superlattices consisting of 15 bilayers of ferromagnetic $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ (LSMO) and SrRuO_3 (SRO) were grown with either stacking order on (1 1 1) oriented SrTiO_3 (STO) substrates using the pulsed laser deposition technique. The Raman spectra of these superlattices show the existence of rhombohedral and orthorhombic crystal structures of LSMO in (111)STO/[11-unit cell (u.c.) LSMO/n-u.c. SRO] $\times 15$ superlattices with $n = 2$ and 3. Interestingly, the Raman spectra of (1 1 1)STO/[11-u.c. SRO/n-u.c. LSMO] $\times 15$ superlattices with $n = 2$ and 3 show only the orthorhombic structure of LSMO. The (1 1 1)STO/[11-u.c. LSMO/n-u.c. SRO] $\times 15$ superlattices exhibit enhanced magnetization with weak antiferromagnetic coupling whereas reduced magnetization with strong antiferromagnetic coupling is observed in (1 1 1)STO/[11-u.c. SRO/n-u.c. LSMO] $\times 15$ superlattices. The observed magnetic properties of these superlattices can be explained by the interfacial structural coupling, as evident from their Raman spectra which suggest a modification in the stereochemistry of Mn at the interfaces.

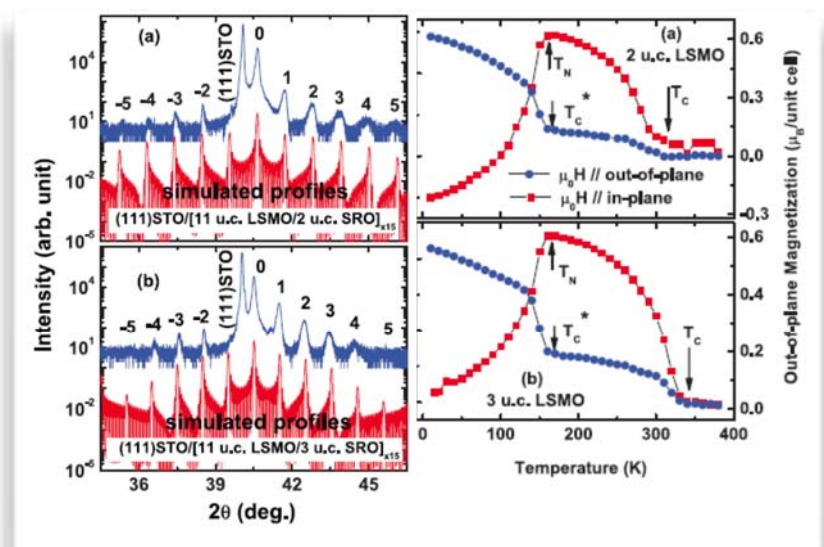


Figure. θ - 2θ x-ray diffraction patterns and simulated profiles of (a) LS-2 and (b) LS-3 superlattices. The (1 1 1) Bragg's reflection of STO as well as the satellite peaks are indicated. Temperature dependent 0.1 T field cooled in-plane magnetization and out-of-plane magnetization of (a) SL-2 and (b) SL-3 superlattices. The arrows indicate TC, TC, and TN.