Magnetism and superconductivity in iron substituted $FeSr_2YCu_2O_y$ cuprates

S. A. Lopez-Paz,[1,2] C. Ritter,[3] A. D. Hillier,[4] and M. A. Alario-Franco[1]

[1] *Inorganic Chemistry Department, Complutense University of Madrid, Avda. Complutense s/n, 28045 Madrid, Spain*
[2] *Department of Chemistry, University of Zürich, Winterthurerstr. 190, 8057 Zürich*
[3] *Institute Laue-Langevin, 71, Avenue des Martyrs, BP 156-38042 Grenoble, Cedex 9, France*
[4] *ISIS Neutron and Muon Facility, STFC Rutherford Appleton Laboratory, Chilton, Didcot, Oxfordshire OX11 0QX, United Kingdom*

Substitution of copper by iron in the charge reservoir block of the YSCO cuprate superconductor brings out an appealing insight on the interplay between superconductivity and magnetism [1, 2]. The resulting $FeSr_2YCu_2O_{7+y}$ compounds are composed of [FeO_{1+y}] layers and CuO_2 bi-layers which alternate along the stacking direction, making them potential layered magnetic superconductors [3]. Indeed, by modifying the hole doping level in $FeSr_2YCu_2O_{7+y}$, we have explored the evolution from a non-superconducting phase with long-range antiferromagnetic order involving both Fe^{3+} and Cu^{2+} cations for $y = 0.08$, to a superconducting sample with $T_c = 70$ K for $y = 0.85$, in which superconductivity coexists with Fe^{4+} long-range magnetic ordering ($T_N = 110$ K $> T_c$) [4]. An intermediate-doped sample, with $y = 0.56$, present a mixed valent $Fe^{3.5+}$ state and superconductivity at a lower $T_c = 30$ K [5]. The delicate charge balance between iron and copper is characterized by combining Mossbauer, X-Ray absorption and electron-energy loss spectroscopies and the novel magnetic structures are characterized by means of neutron diffraction and magnetization measurements. We get a further insight on the eventual interplay between the magnetic and the superconducting interactions in these iron-containing cuprates by means of muon spin relaxation spectroscopy measurements.

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