Superconductivity in the iron-based hydride LaFeSiH

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Since the discovery of unconventional superconductivity in Fe-based materials in 2008, Fe-based superconductors (Fe-SC) have attracted much attention and have been the subject of intense and systematic investigations. To date, Fe-SC always contain pnictogen or chalcogen elements (P, As and Se, Te respectively). Besides, they are usually obtained by solid state reaction with possibly the use of high pressure.

In this context, we have recently synthesized the new hydride LaFeSiH by solid-gas hydrogenation of the precursor LaFeSi. Preliminary results show that this hydride is isostructural to the 1111 Fe-SC compounds and displays superconductivity below 8.5 K (*see Figure*). This hydride also presents other structural, magnetic and electronic similarities with the previously reported Fe-SC compounds. In particular, LaFeSiH undergoes a transition from tetragonal to orthorhombic structure at low temperature, distortion which is suppressed by an external pressure and re-emerges at higher pressure. In addition, DFT calculations have evidenced the quasi-2D character of the Fermi surface with a dominant contribution of the 3d(Fe) orbitals. These calculations also predict the onset of a single-stripe antiferromagnetic order that would explain the orthorhombic distortion. Therefore, LaFeSiH can be considered as the first Fe-SC obtained by solid-gas hydrogenation and free from toxic pnictogen and chalcogen elements.

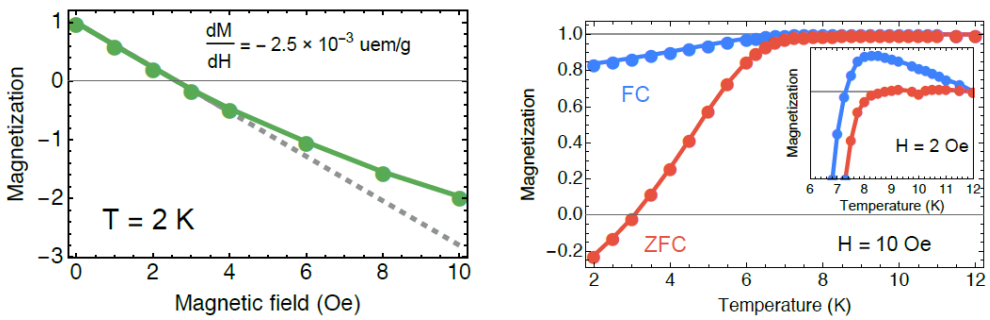

Figure. Normalized magnetization as a function of the magnetic field at 2 K (left) and as a function of the temperature at 10 and 2 Oe (right).