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Effects of pressure on CaFe_2As_2 and related materials¹

PAUL CANFIELD, Ames Lab / Iowa State University

The discovery of CaFe_2As_2 [1] and its extreme pressure dependence [2] (even for pressures below 1 GPa) has led to it being used as a model system for understanding the effects of pressure on the $(\text{AE})\text{Fe}_2\text{As}_2$ ($\text{AE} = \text{Ba}, \text{Sr}, \text{Ca}$) compounds.[3-5] We have found that the combination of extreme pressure sensitivity with a first order structural phase transition that involves significant changes in the unit cell dimensions makes CaFe_2As_2 very sensitive to the pressure medium used. In liquid medium, self clamping cells the higher temperature transitions, while generally detectable and highly reproducible [2,6] are smeared and broadened, especially near the first order phase transition between the low temperature orthorhombic and collapsed tetragonal phases. In He-pressure cells these transitions remain extremely sharp.[3-5] Superconductivity is detected between ~ 0.3 and ~ 0.7 GPa in the liquid medium cells and is essentially absent in the He-pressure cell.[2,5,6] This superconducting region can be associated with a coexistence of low temperature phases brought on by non-hydrostatic components associated with the medium's inability to respond to the high-temperature structural phase transitions.[2-5] The origin of the superconductivity in this mixed region remains a topic of keen experimental and theoretical interest.

[1] N. Ni et al., Phys. Rev. B **78**, 014523 (2008), [2] M. Torikachvili et al., Phys. Rev. Lett. **101**, 057006 (2008), [3] A. Kreyssig et al., arXiv:0807.3032, [4] A. I. Goldman et al., arXiv:0811.2013, [5] W. Yu et al., arXiv:0811.2554, [6] H. Lee et al., arXiv:0809.3550.

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