Effects of pressure on \textit{CaFe$_2$As$_2$} and related materials$^1$

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The discovery of CaFe$_2$As$_2$[1] and its extreme pressure dependence [2] (even for pressures below 1 GPa) has lead to it being used as a model system for understanding the effects of pressure on the (AE)Fe$_2$As$_2$(AE = Ba, Sr, 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$_2$As$_2$ 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 $\sim$0.3 and $\sim$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.

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