Research Highlights

High-*Tc* superconductivity found under high pressure

Drastic enhancement of superconducting transition temperature (*Tc*) can be induced by placing materials under high pressure, state Yoshihiro Kubozono and his team at Okayama University.

In previous studies, Metal-intercalated FeSe's prepared using liquid ammonia technique showed very high *Tc* of 30 - 45 K. With an increase in FeSe plane spacing (*d*), the *Tc* increased rapidly, showing that the increase in two-dimensionality leads to the higher *Tc*.

Until recently, the limit of *Tc* was recognized as 45 K, because of a saturation of *Tc* – *d* plot[1]. Sun *et al.* conducted a study during which, in the pressure-induced high-*Tc* superconducting phase for two metal doped FeSe materials ($Tl_{0.6}Rb_{0.4}Fe_{1.67}Se_2$ and $K_{0.8}Fe_{1.7}Se_2$), the maximum *Tc* reached 48 K[2]. However, such behavior has rarely been reported because it is extremely difficult to conduct the necessary experiments.

In a recent study, Kubozono and his team applied high-pressure to ammoniated Cs doped FeSe ($(NH_3)_yCs_{0.4}FeSe$) material. They measured the temperature dependence of resistance under pressures of between 0 – 41 GPa.

Figure 1. The $(NH_3)_yCs_{0.4}FeSe$ sample prepared by liquid ammonia technique.

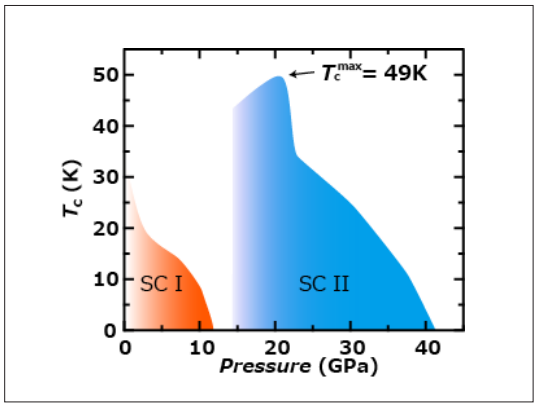

Figure 2: Phase diagram of $(NH_3)_yCs_{0.4}FeSe$.

The *Tc* of $(NH_3)_yCs_{0.4}FeSe$ (31 K at ambient pressure) gradually decreased with increasing pressure, and no superconductivity was observed down to 4.2 K at 11 - 13 GPa. The superconductivity reemerged rapidly above 13 GPa, and a dome-like pressure-dependence of *Tc* was found at 15 - 41 GPa. The maximum *Tc* reached 49 K at 21 GPa.

The emergence of high-*Tc* phase under high pressure may be characteristic for all metal doped FeSe materials, which may provide a hint for realizing higher *Tc* superconductors in two-dimensional layered materials in future.

[1] S. Hosono *et al. J. Phys. Soc. Jpn*. 83, 113704 (2014).
http://journals.jps.jp/doi/pdf/10.7566/JPSJ.83.113704

[2] L. Sun *et al. Nature* 483, 67 (2012).
http://www.ncbi.nlm.nih.gov/pubmed/22367543

Reference:

- Authors: M. Izumi, L. Zheng, Y. Sakai, H. Goto, M. Sakata, Y. Nakamoto, H. L. T. Nguyen, T. Kagayama, K. Shimizu, S. Araki, T. C. Kobayashi, T. Kambe, D. Gu, J. Guo, J. Liu, Y. Li, L. Sun, K. Prassides, Y. Kubozono
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