Poster

Pressure induced superconductor in $Rb_2Mo_6Se_6$

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In the quasi-one-dimensional material $Rb_2Mo_6Se_6$, a charge density wave (CDW) has long been suspected based on the strong resistivity upturn at low temperatures and based on considerations of Fermi surface nesting. A long range ordered CDW has, however, never been observed and the electrical resistivity does not show any clear transition temperature at ambient pressure. In our recent works, we performed electronic transport measurements, high pressure XRD and Raman spectrum in $Rb_2Mo_6Se_6$, three novel phenomena are found :

a) Upon cooling, a upturning of resistance (R) is observed which may be related to a CDW transition, and this phenomenon is suppressed by increasing pressure. b) Temperature (T)-dependent gap E_g forming (upturn R) with $T < 175$ K, while pressure first helps to facilitate local gap formation by increasing the dimensionality and/or locally triggering dimerization, but ultimately suppresses the insulating gap as the system becomes anisotropic 3D transport. c) Pressure changes the q1D ground state from insulator to superconductor (SC). Pressure-induced SC has observed nearly 12 GPa (without any phase transition), and the crystal structure of $P6_3/m$ are stable upto 25 GPa. However, new Raman peaks occurred with P above 4 GPa and 12 GPa, which may be relate to the SC occurrence.

The mechanism behind is the new Raman peak (related to Rb "guest ion phonon mode") as a medium is important for the SC emergency above 12 GPa. This information will help with understanding of q1D materials in the class of $M_2Mo_6X_6$, featuring $Tl_2Mo_6Se_6$, $In_2Mo_6Se_6$, potential candidates for a Tomonaga-Luttinger-Liquid (TLL) [4], their similarities, differences and the options for tailoring of their properties. Upon cooling, a sudden jump of resistance (R) is observed which may be related to a CDW transition, and this phenomenon is enhanced with increasing pressure.

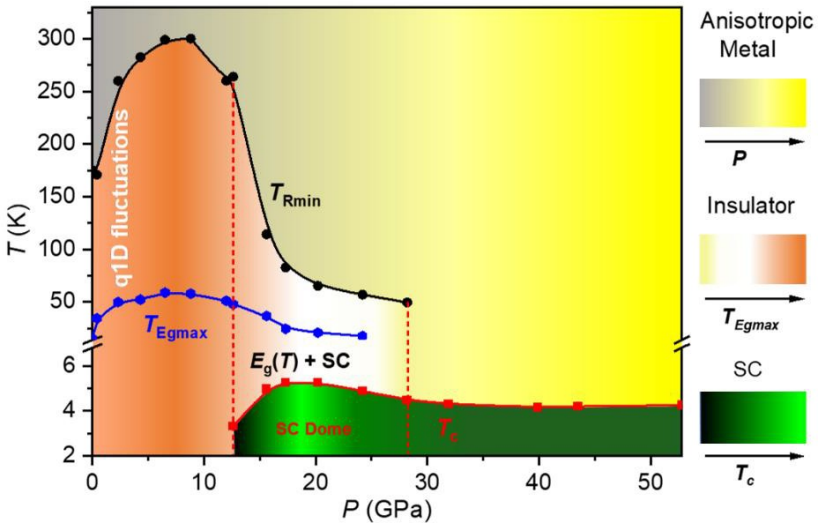

Figure 1. Phase diagram in $Rb_2Mo_6Se_6$ as a function of pressure and temperature.

[1] A. P. Petrović, et al., Phys. Rev. B 82 (2010) 235128.
[2] A. P. Petrović, et al., Nature Communications 7 (2016) 12262.
[3] Q. Liu, A, Zunger, et al., Rev. X 7 (2017) 021019.
[4] K. Nakayama, et al., Phys. Rev. B 98, 140502(R) (2018).