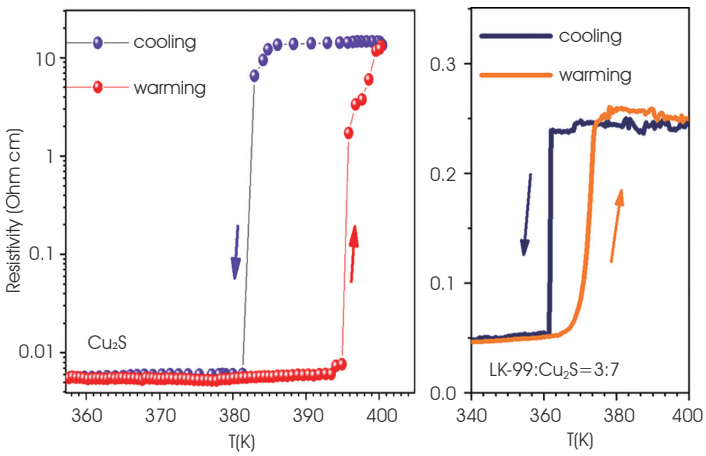
The Myth of Room Temperature Superconductivity in LK-99 Is Busted

Basic Research

Sukbae Lee *et al.* from South Korea claimed that the $Pb_{10-x}Cu_x(PO_4)_6O$ ($0.9<x<1.1$), dubbed LK-99, is a superconductor at ambient pressure with T_c up to 127°C (400 K). The shocking news stimulates scientists and people on social media due to its potential impact on technology. As *Nature* News reported, it has become a viral sensation and prompted a slew of replication efforts by scientists and amateurs alike. Several groups attempted to replicate the results, but none provided direct evidence for superconductivity. The most mysterious is what the sharp decrease in resistivity comes from and why it only appears in a few samples.

A team from the Institute of Physics (IOP) of the Chinese Academy of Sciences (CAS) led by Prof. LUO Jianlin noted that the LK-99 made by Lee *et al.* contained a certain amount of Cu_2S impurity, which undergoes a structural phase transition from the hexagonal structure at high temperature to the monoclinic structure at low temperature near 400 K. They found that the resistivity of Cu_2S decreased by 3 to 4 orders of magnitude around 385 K, close to the reported transition temperature in references. Additionally, they measured the resistivity of the mixture of LK-99 and Cu_2S, which showed a sharp resistivity transition at the temperature consistent with the reported findings, but without zero resistance.

It is important to note that this first-order structural transition differs significantly from the second-order superconducting transition. They observed a thermal hysteresis behavior in the resistivity and magnetic susceptibility measurements, which proves it is a first-order transition and cannot be a second-order superconducting transition. The findings strongly suggest the superconducting-like transition in LK-99 as reported by Lee *et al.* originates from the first-order structural transition of the impurity phase of Cu_2S.



Temperature dependence of resistivity of Cu_2S, LK-99 including Cu_2S (Image by IOP)

Their results provide solid evidence that LK-99 is non-superconducting and put an end to the rumors.

This study entitled "First order transition in LK-99 containing Cu_2S" was published in *Matter*.

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