Superconductivity above 10 K in a novel quasi-one-dimensional compound

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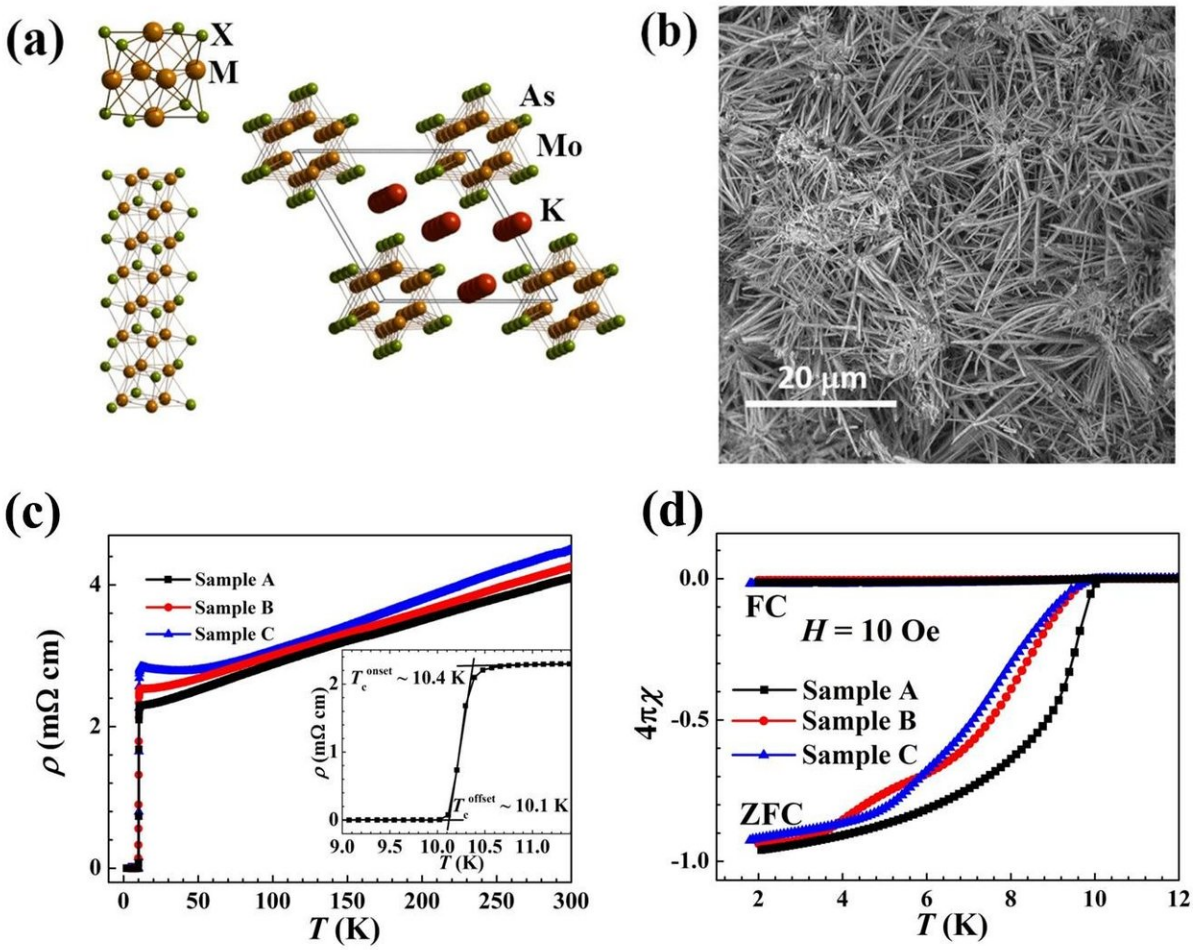

(a) the schematic crystal structure for $K_2Mo_3As_3$; (b) the SEM morphology characterization for the fresh fracture surface of the $K_2Mo_3As_3$ polycrystalline sample; (c) the temperature dependence of electrical resistivity for three typical polycrystalline $K_2Mo_3As_3$ samples; (d) the temperature dependence of dc magnetic susceptibility for three samples of $K_2Mo_3As_3$. Credit: Science China

In the past century, superconductivity has been observed in thousands of substances with multifarious chemical compositions and crystal structures; however, researchers have still not found an explicit method for discovering new superconductors. For the unconventional high-Tc superconductors of cuprates and iron pnictides/chalcogenides, the occurrence of superconductivity is highly related to the existence of some certain quasi-two-dimensional structural motifs, e.g., the CuO_2 planes or the Fe_2As_2/Fe_2Se_2 layers. Thus, low dimensionality has generally been considered as a favorable ingredient for exotic electron pairing due to the enhancement of electronic correlations. While among the quasi-one-dimensional (Q1D) compounds, only a few compounds were found to be superconducting at considerably low temperatures of several degrees Kelvin.

Recently, a team led by Prof. Zhian Ren from the Institute of Physics, Chinese Academy of Sciences discovered a Q1D superconductor $K_2Mo_3As_3$, with a Tc value exceeding 10 K for the first time. Although many molybdenum chalcogenide superconductors were discovered in the 1970s, ternary compounds of molybdenum arsenide have rarely been reported. After much study of Mo-based ternary phases, the team succeeded in synthesizing the new $K_2Mo_3As_3$ compound, which crystalizes in a noncentrosymmetric hexagonal structure with typical Q1D $(Mo_3As_3)^{2-}$ linear chains separated by K+ cations, similar to the structure of $K_2Mo_3As_3$. Bulk superconductivity below 10.4 K was confirmed by electrical resistivity, magnetic susceptibility, and heat capacity measurements. The $K_2Mo_3As_3$ is the first MoAs-based superconductor and possesses the record Tc in all Q1D superconductors. This discovery indicates that Cr and Mo based Q1D superconductors may share some common underlying origins within the similar structural

motifs and will help to uncover the exotic superconducting mechanism in low dimensional materials.

More information: Qing-Ge Mu et al, Superconductivity at 10.4 K in a novel quasi-one-dimensional ternary molybdenum pnictide K 2 Mo 3 As 3, *Science Bulletin* (2018). DOI: 10.1016/j.scib.2018.06.011

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