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Title of the Presentation: Cuprate high-temperature superconductivity in the extreme two-dimensional limit

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Short Biography:

He joined Yuanbo Zhang's group as an undergraduate in 2016 where he worked on atomically thin BSCCO thin film. In order to investigate the dimensional effect on this traditional high Tc superconducting material, he used scanning tunneling microscope and transport measurement to characterize the monolayer $Bi_2Sr_{2-x}La_xCuO_{6+\delta}$ and found the monolayer cuprate, which contained only one Cu-O plane, was still superconducting. He received bachelor degree of physics at Fudan University in 2018 and became a graduate student at Fudan University. Now he focused on fabricating transport devices in UHV environment.

Abstract:

Atomically-thin layered van der Waals crystals represent ideal material systems in the two-dimensional limit. The reduction in dimensionality fundamentally alters the electronic structure of the materials, often with profound consequences as best exemplified by the emergence of Dirac fermion in graphene[1],[2]. Vast opportunities arise in extending this top-down approach to other material systems. Recent experiment has demonstrated that two CuO_2 planes contain all essential physics of high-temperature superconductivity[3]. Here, we study cuprate superconductor in the ultimate two-dimensional limit—monolayer of $Bi_2Sr_2CuO_{6+\delta}$ (Bi2201) that contains only one CuO_2 plane. Even though the high-temperature superconductivity, along with various other correlated phenomena, persists in the monolayer, a slight drop in the superconductivity transition temperature T_c may indicate effect from reduced dimensionality. The extreme thickness brings unprecedented tunability; we are able to cover the entire phase diagram of Bi2201 with controlled oxygenation in a single monolayer specimen. Our results establish Bi2201 as a new two-dimensional material with highly tunable high-temperature superconductivity.

[1] Novoselov, K. S. et al. Two-dimensional gas of massless Dirac fermions in graphene. Nature. 438: 197-200 (2005).

[2] Zhang, Y. et al. Experimental observation of the quantum Hall effect and Berry's phase in graphene. Nature. 438: 201-204 (2005).

[3] Yu, Y. et al. High-temperature superconductivity in monolayer $Bi_2Sr_2CaCu_2O_{8+\delta}$. Nature. 575: 156-163 (2019).