Antiferromagnetic ordering within a single layer of organic superconductor

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We present scanning tunneling microscopy and spectroscopy to study the interplay between superconductivity and magnetism in a single layer organic d-wave superconductors $(BETS)_2GaCl_4$ on Ag(111). Antiferromagnetic molecular chains of $GaCl_4$ are spontaneously formed within the superconducting single layer due to shortages of BETS dimers. Below transition temperature of 7K, the superconducting order masks the antiferromagnetic order and dominates the electronic properties showing a ubiquitous gap over the entire island with proximity effect across the island/Ag(111) interface. These features gradually decay with the rise in temperature giving way to a Kondo dip on $GaCl_4$ chains with additional inelastic vibronic features on $(BETS)_2GaCl_4$ stripes. The concurrent absence of these signals below T_c may be related to a renormalization process where both phonon and antiferromagnetic fluctuation exhibit a cooperative existence to mediate superconductivity in such d-wave superconductors.

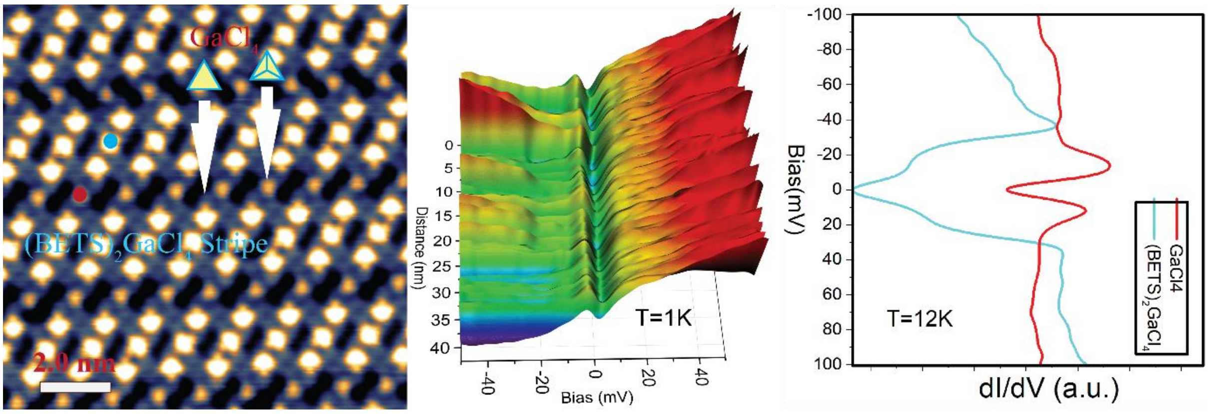

Figure 1. Atomically clean interfaces between superconducting stripes and antiferromagnetic chains are spontaneously formed within a single layer of charge transfer complex $(BETS)_2GaCl_4$. Low level excitations that dominate the higher temperature phase are absent below T_c which point to their possible renormalization to mediate superconductivity in such d-wave superconductors.

Reference

[1] A. Hassanien B. Zhou and A. Kobayashi, Adv. Electron. Mater. 2020, 2000461.