Exploring Layered Conductors by 3D FIB micro-machining.

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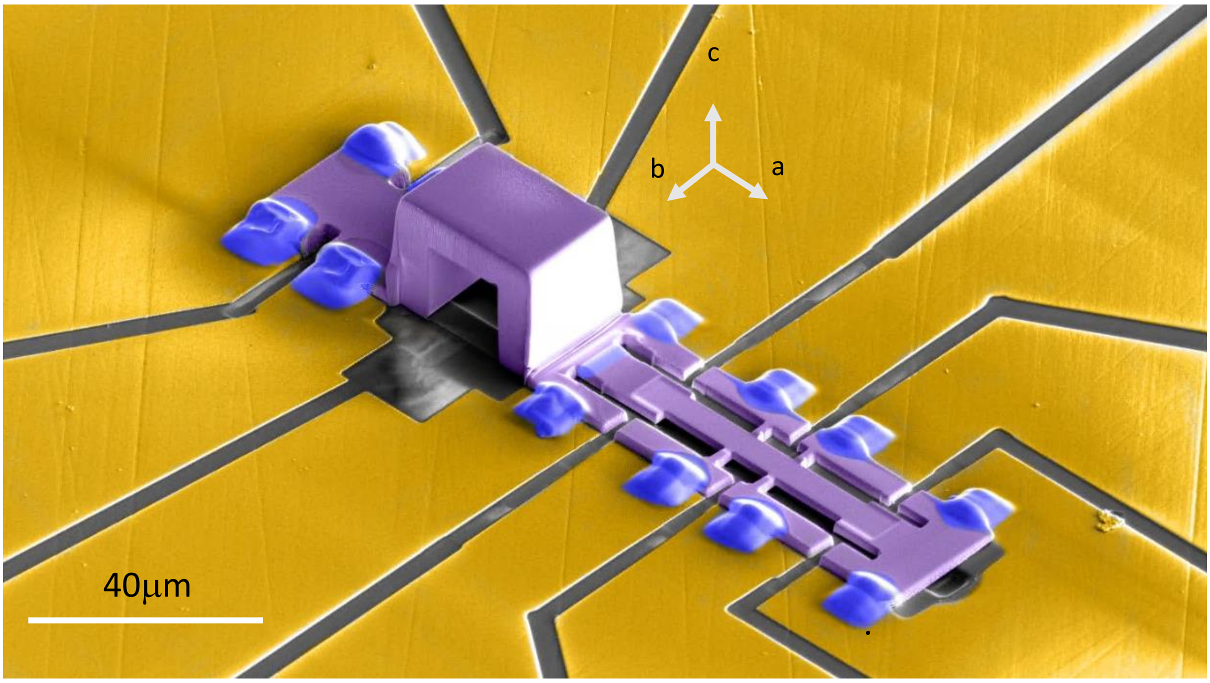
Some of the most enigmatic correlated states in the field of quantum matter arise in lower dimensions such as quasi-2d and quasi-1d materials. The layered crystal structure in organic and high-T_c superconductors is an example of these materials, where a quasi-2D electronic structure gives rise to several unconventional electronic instabilities. The layered crystal structure allows for exfoliation in some materials which helped to uncover electrical transport properties such as the quantum Hall effect as well as enables spectroscopic probes in single layer and few layer systems. It is the same crystallographic anisotropy that hinders the study of interlayer electrical transport and spectroscopic probes such as angle resolved photoemission spectroscopy (ARPES).

In my talk I will demonstrate the novel experimental capabilities that focused ion beam micro-structuring enables in studying layered conductors. Confining the in-plane dimension of quasi-2D high purity metals of the Delafossites to length scales smaller than the electron mean free path gives rise to a novel realization of the particle-wave duality[1,2].
Beyond these exciting physical phenomena of finite size confined pillars, novel experimental possibilities will be presented which enable previously inaccessible insight into layered materials.

1. M.D. Bachmann, et al. Nature Physics (accepted 2022), arXiv:2103.01332
2. C. Putzke, et al. Science 368, 6496 (2020)



Scanning electron microscope image of a 3D PdCoO2 micro-structure enabling to study the interplay between inter- and intra-layer electrical transport.