Topological frustration in Organic topological insulators

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Topological insulators are a recently discovered class of materials exhibiting interesting properties for applications such as quantum computation devices. Recently, metal-organic coordination networks (MOCN) have been theoretically proposed as the organic counterpart of topological insulators [1]. Despite the experimental achievement of several of the proposed MOCN, their edge state visualization, which is the fingerprint of 2D topological insulator, remains elusive [2,3].

We have formed one of these proposed MOCN with expected topological insulator character using 9,10-dicyanoanthracene molecules and Cu ad atoms on a Cu(111) substrate. The lattice extends throughout the surface as single-domain and exhibits an almost perfect order. By means of scanning tunneling spectroscopy and angle-resolved photoemission spectroscopy we have studied in depth its electronic structure, but find total absence of an edge state despite the excellent MOCN order. Functionalized tip measurements and tight-binding calculations suggest that structural asymmetries drive the networks into a topologically trivial case that destroys its edge state [4].

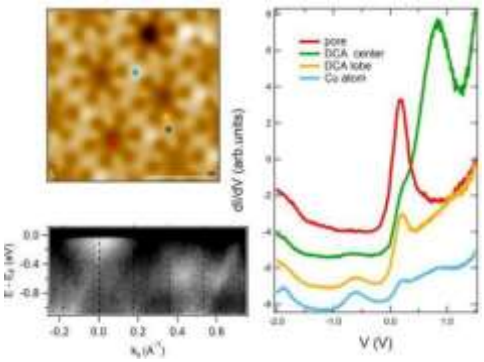

Figure 1 – Topography and electronic structure of DCA-Cu metalorganic network

[1] Z. F. Wang, Z. Liu and F. Liu, Nat. Comm 56 (2013) 1471.
[2] L. Yan, I. Pohjavirta, B Alldritt and P. Liljeroth, ChemPhysChem. 20 (2019) 2297.
[3] H. Sun et al., Journal of Phys. Chem. C. 122 (2018) 18659.
[4] L. Hernández-López et al., Nanoscale 13 (2021) 5216.