Tailoring quantum confinement using extended organic nanoporous networks

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Organic nanoporous networks grown on (111) noble metal surfaces are highly successful model systems to study scattering electron phenomena. On such surfaces, the 2D molecular scaffolds are able to confine the surface state electrons and are commonly named “quantum dot arrays” [1-5]. The resulting confined states result in sizable energy shifts of the Shockley states and the formation of shallow bands, as a results from the repulsive scattering at the molecular walls and partial quantum confinement within each pore [1-5].

We have studied 6 extended 2D nanoporous networks grown on noble metal surfaces which yield single domain structures. Our findings show that depending on the geometry and building units it is possible to tune the energy shifts in opposite directions (towards and away from the Fermi energy), independently of the substrate. The nature of this effect is related to metal-organic overlayer-substrate interactions in the form of adatom-surface state hybridizations. The electronic structure in all cases is determined by two state-of-the-art, highly complementary techniques (STM and ARPES), and supported by first principles and model calculations.

References

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Figures

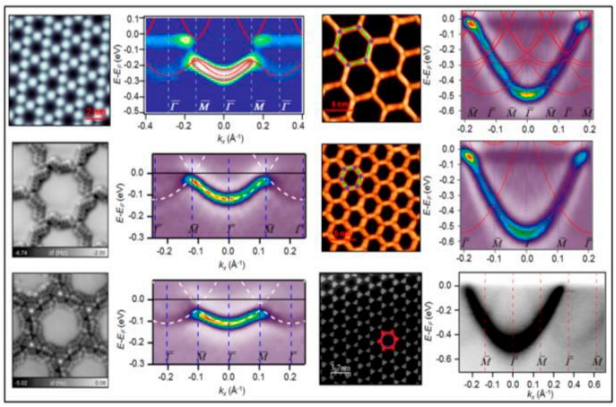

Figure 1. STM topographies and corresponding band structure of six different single domain nanoporous networks that give rise to quantum dot arrays. The fundamental energy of the bands can either shift towards the Fermi energy or away from it, even if in all cases there is evidence of electronic confinement.