Electronic imprint of closed shell adsorbates in 2D quantum well arrays: nano - “Pillow effect”

Olha Popova[1], Jonas Björk[2], A. Ahsan[1], F. Mousavi[1], Meike Stöhr[3], Lutz H. Gade[4], Jorge Lobo-Checa[6] and Thomas A. Jung[5]

[1]*Department of Physic, University of Basel, Klingelbergstrasse 82, 4056 Basel, Switzerland;*
[2]Department of Physics, Chemistry and Biology, IFM, Linköping University, Linköping 581 83,Sweden;
[3]Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands;
[4]*Anorganisch-Chemisches Institut, Universität Heidelberg, Im Neuenheimer Feld 270, 69120 Heidelberg, Germany;*
[5]*Laboratory for Micro- and Nanotechnology, Paul Scherrer Institute, 5232 Villigen PSI, Switzerland;*
[6]*Instituto de Ciencia De Materiales de Aragón (ICMA), CSIC-Universidad de Zaragoza, E-50009 Zaragoza, Spain;*
olha.popova@unibas.ch

2D Periodic arrays of quantum dots arise from the interaction of on-surface organic networks with free electron like Shockley states. The spatially periodic interaction of the network backbone with the surface state leads to detectable, localized electronic states that form a coherent Bloch wave [1, 2]. We investigate the electronic imprint left by the adsorption of octa-ethyl-porphyrin (OEP) in the pores of a perylene derivative (DPDI) metalorganic network. By combining non-local angle resolved photoemission spectroscopy (ARPES), and local scanning tunneling microscopy (STM) and scanning tunneling spectroscopy (STS) experiments we find that the electronic states in the porous network are strongly modified by the guest OEP molecules. These effects are visualized locally upon the neighbouring confined states and mesoscopically as band changes upon the quantum dot band structure (Bloch states). This host-guest system provides an excellent nanometer scale playground to investigate the ‘pillow effect’ originating from Pauli repulsion.

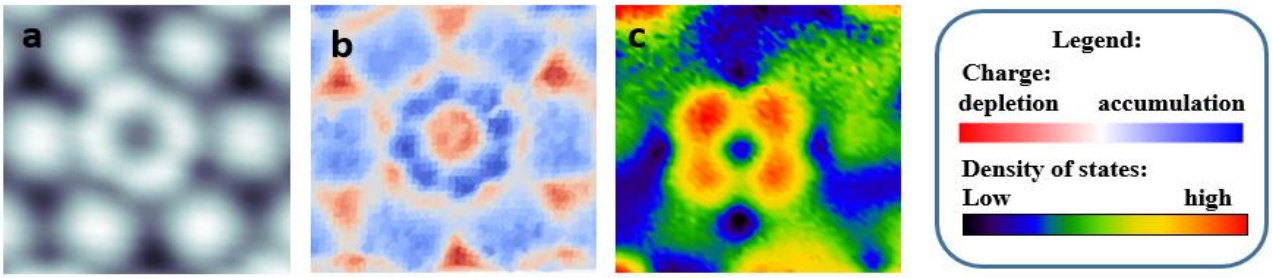

Fig.1 ***(a)*** *STM topographic image of a pore occupied by an adsorbed ZnOEP molecule and its corresponding conductance dI/dV map recorded at 80 meV* ***(c)*** *(showing the position dependent density of states)* ***(b)*** *and the I(z) work function map. All data has been recorded at 5K. Note that the work function map identifies a lower symmetry than hexagonal for the porous network, as three out of six nodes appear brighter (more red) and are therefore more charge depleted.*

References:
[1] J. Lobo-Checa, et al, Science 325, 300 (2009);
[2] S. Nowakowska, et al, Nano Letter**,** (2017);
[3] O.Popova, et al, in preparation.