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Coulomb blockade and charge ordering in a few layers of TTF-TCNQ investigated by low-temperature STM/STS[1] SEOKMIN JEON, PETRO MAKSYMOVYCH, Oak Ridge National Laboratory — In contrast to the vast effort on bulk crystal phases of the prototypical organic charge-transfer complex, TTF-TCNQ, study of low-dimensional phases has been limited to monolayer phases on substrates. In this state, however, none of the physics of the bulk phase is observed owing to the overwhelming effect of the substrate. We investigate the molecular structure and electronic properties of a few layers of TTF-TCNQ grown on Au(111) and Ag(111) using STM/STS at 4.3 K. By decoupling the molecular electronic state from the metal surface, we have made the first observation of the effect of confinement on the electronic properties of TTF-TCNQ. STS reveals a plethora of sharp features due to molecular orbitals, each influenced by charge-transfer between the molecules. We hypothesize the existence of a Mott-insulator state in 3-layer islands, with a Coulomb gap of ˜1 eV. In contrast, the corresponding bulk phase is a Peierls insulator with a gap of ˜20 meV. The root cause of the nanoscale phase is traced to simultaneous electron confinement and structural frustration, which dramatically modify the energy balance of self-ionization allowing for integer charge transfer. These studies open broad opportunities to explore correlated electron physics in molecular systems.

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