Evidence of Coulomb blockade behavior in a quasi-zero-dimensional quantum well on TiO_2 surface

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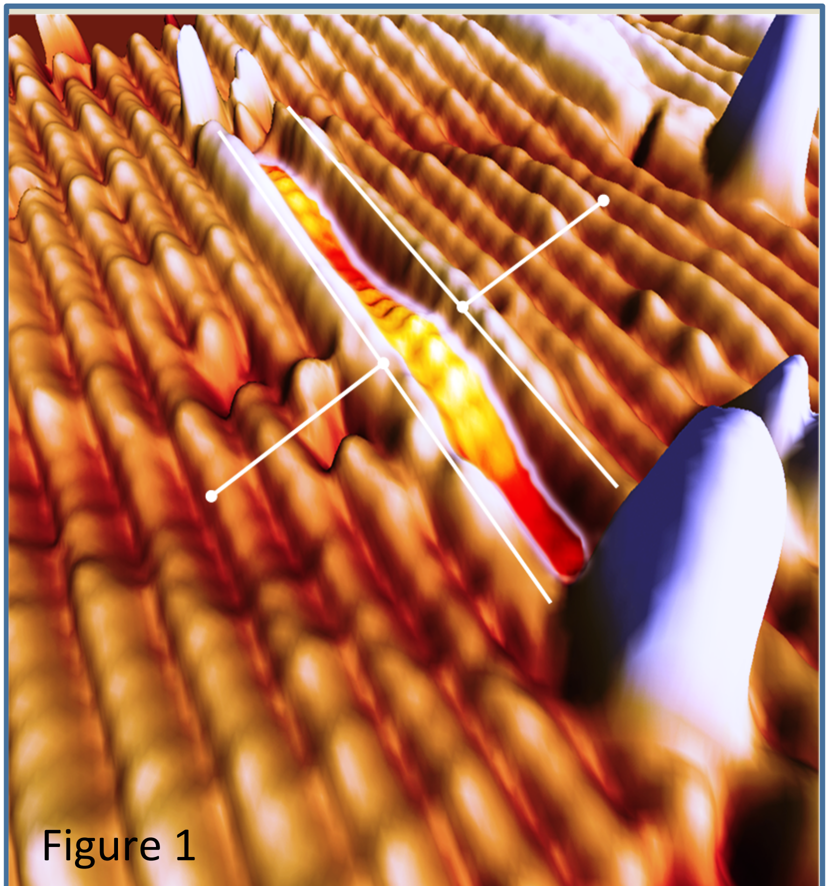
•The effect of strong electron-electron correlations on discrete quantum states, confined in self-assembled nanostructures, was reported using scanning tunneling microscopy and first principles calculations. 10 to 20-nm long line defects form in pairs, separated by 1.2 nm creating a quantum well on the surface of TiO2(110). Inside the quantum well, a long wavelength oscillatory feature of the local density of states is observed *at room temperature* and attributed to the formation of electronic standing wave for the lowest energy quantum state. Electron-electron repulsion and consequently charging energy must be included to explain the observed spatial distribution of the charge density. This observation opens up the possibility of experimentally imaging the transition from a strongly correlated behavior of the Coulomb Blockade in a zero-dimensional system to an independent-particle or band-like behavior in an extended one-dimensional system.



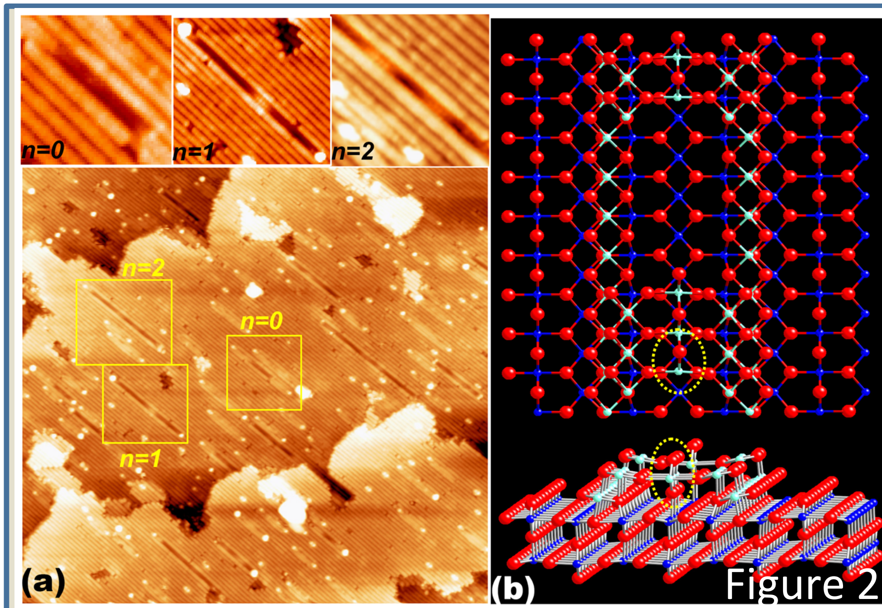


Fig. 1. (A) Three-dimensional STM image of a 10 nm long “nanoclip” nanostructure on TiO_2(110) substrate. A 3.8 nm period oscillation is observed between the two ends of the linear Nanoclip.
Fig. 2. (A) STM image for a large area scan (85 × 85 nm^2, 0.5 nA) exhibiting a number of double-line-defects (nanoclips), which show the observable charge oscillation inside. (B) Ball-and-stick structural model of a typical “nanoclip” viewed from the top and the side (Ti: light blue (nanoclip), dark blue(surface); O: red).

This research published in PNAS 107, 14968(2010), was conducted at the Center for Nanophase Materials Sciences, which is sponsored at Oak Ridge National Laboratory by the Scientific User Facilities Division, U.S. Department of Energy. E.W.P. was supported by DOE #DESC0002136.