SFB 767
Seminar

Universität Konstanz

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P 602

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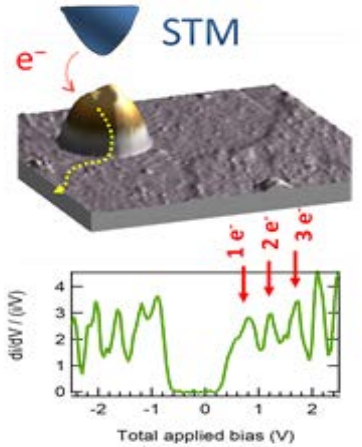
Single charge electronics with gold nanoparticles and organic molecules

Nanoparticles can be used as ultimate electrical materials for storing electrons or controlling their flow for the next generation nano-electronic devices. These particles are the core element of assemblies where the electrical current is reduced to the smallest possible since electrons are controlled one by one by using the Coulomb blockade phenomenon.
We prepared colloidal gold nanoparticles of 6 nm and grafted them on a grafted organic monolayer (GOM) on silicon. GOM are highly ordered monolayers prepared by hydrosilylation of alkene molecules and subsequently modified with an amine group so that gold nanoparticles can be firmly immobilized on top of the layer. A wide range of characterization methods were used to assess the preparation: AFM, STM, Scanning Tunnel Spectroscopy (STS), High Resolution-TEM, XPS, FTIR and UV-visible spectroscopy [1, 2].
We will mostly discuss several electrical properties at a single electron level. By placing an STM tip above a nanoparticle, Coulomb blockade allows controlling the number of electrons simultaneously injected in the nanoparticle [1, 3]. Using the conductive tip of KPFM, we were also able to reveal the spontaneous charging behavior of the gold nanoparticles [4]. This opens the way for new kinds of single electron memories or single electron transistors.



Investigation with the STM of the transport properties of gold nano-particles chemically attached to an organic mononlayer on silicon. Coulomb blockade is detected with transfer of single electrons.

[1] Caillard L , Sattayaporn S, Lamic-Humblot A-F, Casale S, Campbell P, Chabal Y J, and Pluchery O, Nanotechnology 2015 (26) 065301 [2] Pluchery O, Caillard L, Benbalagh R, Gallet J-J, Bournel F, Zhang Y, Lamic-Humblot AF, Salmeron M, Chabal YJ, Rochet F, Phys. Chem. Chem. Phys. 2016, 18, 3675 [3] Pluchery O, Caillard L, Dollfus P, Chabal YJ, J. Phys. Chem. B 2018, 122 (2), 897 [4] Zhang Y, Pluchery O, Caillard L, Lamic-Humblot A-F, Casale S, Chabal YJ, Salmeron M, Nano Letters Nano Lett 2015 (15) 51

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