Coulomb blockade observed on a nano-sized gold cluster with pendulum AFM

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Ultrasensitive cantilevers in the pendulum geometry can be used for probing a wide range of electronic properties of surfaces [1,2]. Due to the high force sensitivity (aN/Sqrt(Hz)) and small internal friction coefficient (10^{-12}Kg/s) we have also access to probe dissipation mechanisms of different materials.

Deposition of nano-sized clusters of gold on 4ML insulating NaCl film grown on Cu(100) results in the formation of Au-Quantum Dots (Au-QDs) coupled to the Cu electron reservoir underneath. System composed of Au-QDs, NaCl tunneling barrier and Cu back electrode is a tunneling junction and an AFM tip positioned on top of the QD is a probing gate electrode coupled capacitively to it. Thus, we are able to investigate the electronic structure of an individual Quantum Dot.

Results show the change of dissipated power as a function of the bias voltage applied between tip and Cu sample. Observed peaks in the dissipation signal are attributed to charging and de-charging events of a QD. The distance between the observed spikes allows us to calculate the charging energy of the nano-sized Au clusters. Furthermore, constant height energy dissipation images reveal how the energy is dissipated in the space around the Au quantum dot.

References

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