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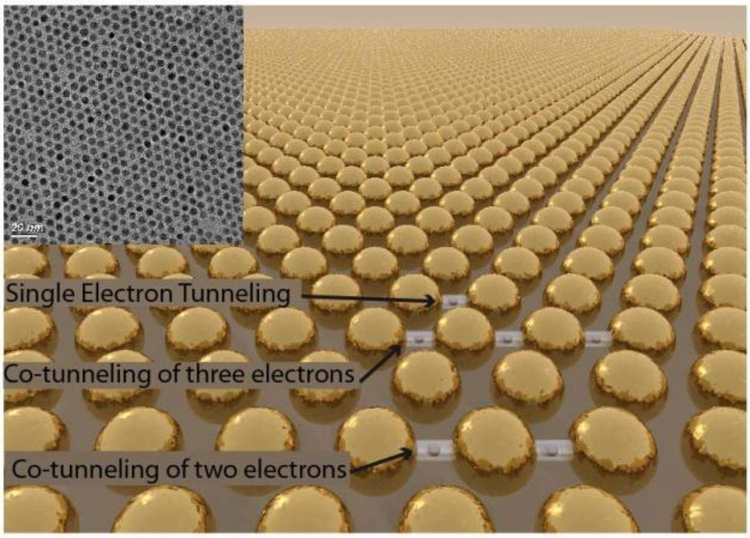
Quantum co-tunneling in nanoparticles arrays

Thanks to the development of synthetic methods allowing the preparation of highly monodisperse population of nanoparticles, self-organized nanoparticles arrays can be obtained with the Langmuir method. Owing to the small size (2-7 nm) of nanoparticles, the capacity of nanoparticles to store charges is very small; this translates into a high Coulomb energy for adding one electron into a nanoparticle. For this reason, nanoparticle arrays can be used as model systems for the study of electronic transport in presence of strong Coulomb interactions where quantum correlations effects are large.



In this work done in LPEM, we have studied the evolution of transport properties of gold nanoparticle arrays as the width of the tunnel barrier separating nanoparticles is tuned through chemical linking of the nanoparticles with alkane chains of various lengths.

We have shown that we could identify two distinct regimes of electronic transport. In arrays where the electronic linking is obtained with long alkane chains, electronic transport is activated and follows Arrhenius laws. In arrays where the electronic linking is obtained with short alkane chains, electrons diffuse through quantum co-tunneling, allowing them to overcome the Coulomb energy and led to Efros-Shklovskii type transport laws.

1. Moreira, H. *et al.* Electron Cotunneling Transport in Gold Nanocrystal Arrays. *Physical Review Letters* **107**, 1-5 (2011).