Tu-P-24 - Session Poster session 1. Tuesday, June 25, 2013, 16h00

**Origin of Noise in Structures with Tuned Nanoconstrictions**

V. Sydoruk1, L.K. Vaudanne2, M. Petrychuk3, S. Pud3, J. Li4, D. Mayer3, S. Vitusevich5

1Peter Grünberg Institute/Forschungszentrum Jülich, 52425 Jülich, Germany
2Eindhoven University of Technology, Eindhoven 5600MB, Netherlands
3Tara Shevchenko National University, Kiev 01033, Ukraine
4*Corresponding author: s.vitusevich@fz-juelich.de

**Abstract**

Structures with thin regions in the range of tens of nanometers, whose geometry can be tuned, represent unique systems for studying noise properties at the nanoscale. Such structures are attracting increased attention in terms of fundamental studies and future applications.

In this work, we have analyzed the transport and noise properties of gold nanostructures with nanoconstrictions, the geometry of which can be scaled down to a single gold atom. Moreover, after breaking the gold constriction and bonding the electrode with a single organic molecule, the structure demonstrates unique behavior with respect to the molecule transport and noise properties. The studied structures contain the nanoconstriction region (of 40x40x40nm$^3$) size) which can be tuned using a mechanically controlled system. Transport and noise characteristics were monitored during the tuning process with and without molecules. The obtained dependencies of normalized noise spectra are shown in Figure 1 for the case of pure gold constriction (black points) and a 1,4-benzeneedithiol (BDT) molecule bonded between the gold nanocontacts (red points).

![Figure 1](image)

Figure 1: (a) Normalized noise power spectra as a function of resistance of the sample with and without BDT molecule at 10 kHz; (b) The simulation results show good agreement with part of the experimental results.

We observed four typical dependencies: (1) at low and medium values of resistance (without molecules). The relative noise increases with the resistance as: $S_N/R^2 \propto R^{-1/2}$; $3/2 \leq m \leq 2$; (2) at very high values (60 kΩ) of resistance (without molecules). The relative noise remains mostly constant. The resistance and constant value of noise are expected to increase and are discussed; (3) at low values of resistance (with molecules) the results are similar to case (1) reflecting that the parallel path to the metal is of no significance; (4) at higher values of resistance (with molecules), when the interface area between the molecule and gold plays an important role, the relative noise is lower than the noise in the case of the system without a molecule.