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Electronic properties of atomic-scale wires from direct two-probe STM experiments

We will present our recent results obtained on the new Scienta-Omicron low temperature ultra-high vacuum 4-probe STM (LT-Nanoprobe). This unique machine is equipped with 4 STM scanners able to operate on the same surface simultaneously with the stability comparable to the best single tip low temperature STMs [1].
Firstly, we will show our methodology for fine relative positioning of two STM probes on Ge(001) and Ge(001):H surfaces with unprecedented atomic precision and with a lateral exact probe to probe distance below 50 nm. Moreover, we will discuss our design of the 2-probe experiment, in which a DC bias voltage on one of the probes is modulated by small AC component. Then, two lock-in amplifiers demodulate resulting current signals on each of the probes, what gives corresponding dI_1/dV_1 and dI_2/dV_1 signals. Our method allows a direct testing of the electronic transport through atomic-scale structures in a fully planar geometry, what will be shown on an example of a model system: bare Ge dimer wire supported on Ge(001) and Ge(001):H surfaces. In this case we determine ballistic transport regimes in the atomic wire by systematic 2-probe experiments on the probe to probe distances below 50 nm.
Finally, we will present perspectives for application of the discussed methodology to molecular structures supported on non-metallic substrates, i.e. molecular wires obtained by the on-surface synthesis approach on metal oxide surfaces [2-4].

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References

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