Quantum phenomena, such as electron tunneling, play an important role for devices with functional structures at the nanometer scale. We report investigations on monolayers of small metal clusters by means of scanning tunneling microscopy (STM) and spectroscopy (STS). Monte-Carlo simulations were carried out in accordance with the experimental situations.

**Experimental Results**

STM image of deposited Au clusters, obtained at 7 K, scan range: 7 x 7 nm², and I-V curves acquired: (a) above the center of a cluster, showing Coulomb staircase (CSC); (b) away from the center and near a neighboring cluster, showing negative differential resistance (NDR); (c) above a cluster which belongs to the second layer, showing only Coulomb-Blockade (CB).

**Discussion for case (b)**

"Gate" effect as reason for NDR

\[ C_T \text{ not negligible} \]

If \( IV-V_I > e/2C_{2S} \)

Tunneling \( 2 \rightarrow S, \ V_{21} \)

\[ d_{12} > d_{1S}, d_{2S} \]

Classical physics: \( C_{1S} < C_{1S'}, C_{2S} \)

Tunneling regime: \( C_{1S} > C_{1S'}, C_{2S} \) [2]

**Conclusions**

- \( I-V \) characteristics of monolayers of Au₃₅ clusters were investigated with a low temperature STM.
- Apart from the usual charge-quantization phenomena, such as Coulomb blockade and staircase, negative differential resistance (NDR) was observed at well defined positions.
- NDR can be explained by a "gate" effect caused by neighboring clusters and involving a nonclassical behavior of the capacitances in the tunneling regime.


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