Molecules on insulating films: scanning-tunneling microscopy

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<u>STM – to – Molecule Transport</u>

Working principle of a STM
Modes of operation



(from Moresco, Physics Reports 2004)

Recent STM – M experiments

REPORTS

Development of One-Dimensional Band Structure in Artificial Gold Chains

N. Nilius, T. M. Wallis,* W. Ho†

SCIENCE VOL 297 13 SEPTEMBER 2002

- Au on NiAl(110)
- Vacuum STM at 12 K





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Insulating film



We consider STM – molecule junctions as strongly asymmetric double tunnel junctions.



Controlling the Charge State of A Individual Gold Adatoms

Jascha Repp,¹* Gerhard Meyer,¹ Fredrik E. Olsson,² Mats Persson²

SCIENCE VOL 305 23 JULY 2004





Molecules on Insulating Films: Scanning-Tunneling Microscopy Imaging of Individual Molecular Orbitals

Jascha Repp and Gerhard Meyer

IBM Research, Zurich Research Laboratory, CH-8803 Rüschlikon, Switzerland

Sladjana M. Stojković, André Gourdon, and Christian Joachim

CEMES-CNRS, 29 rue J. Marvig, P.O. Box 4347, F-31055 Toulouse Cedex, France (Received 23 September 2004; published 19 January 2005)



Pentacene molecules on one and two layers of NaCl on

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Molecules on insulating films

Some details

- Pentacene on a few atomic NaCl on Cu(111) and Cu(100)
- NaCl is evaporated thermally at 220 to 300 K
- Defect-free NaCl islands of up to three atomic layers
- NaCI has a wide band gap of 8.5 eV
- Individual molecules are adsorbed at 5 K
- Scanning Tunneling Spectroscopy at 5 K
- "Pentacene Tip"
- Constant-Current mode with d ~ 1-4 Å, J ~ 10-30 pA
- Using Au atom to determine exact position of Pentacene
- Calculations by Elastic Scattering Quantum Chemistry

Pentacene molecules on NaCl(100)/Cu



Calculated images



Atomic Scale Conductance Induced by Single Impurity Charging

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