Introduction

The electronic and optical properties of matter are considerably changed due to quantum effects when the size of the objects is reduced to atomic-scale dimensions. The focus area NanoScale “Functional Materials at the Nanoscale” in the Freie Universität Berlin, aims at a profound understanding of these properties and to develop functional materials (in particular consisting of organic molecules) which may lay the basis for future nanotechnology.

This workshop will bring together experts from two communities investigating properties of single-molecule junctions: the first one investigates the electronic properties and mechanical flexibility of molecules by using a combination of scanning tunneling microscopy (STM) and atomic-force microscopy (AFM). Whereas STM is a standard tool for electronic structure determination with atomic-scale precision, AFM has recently been shown to provide information of electrostatic potentials with unprecedented resolution. This information is crucial for the design of molecular junctions with specifically desired conductance properties. Furthermore, the combination of STM and AFM provides insight into the flexibility and mechanical stability while a current is flowing through the molecular junction.

The second community investigates the optical properties of nanoscale junctions by a combination of light spectroscopy and STM. The light emission from molecule-metal junctions gives insights into the plasmon spectrum of the nanoscale cavity and its interaction with the molecule placed inside the junction. The interplay of electronic excitations and light forms a basis for the development of optical devices.

Both communities have recently shown rapid progress towards the understanding of elementary processes in single molecules at the atomic-scale. This knowledge provides a basic playground for design strategies of nanoscale devices - a vision also pursued within the focus area NanoScale.

This workshop aims to unify the two scientific communities in light and atomic force spectroscopy which up to date are unrelated, despite the common field of research through the combination with scanning tunneling microscopy.
<table>
<thead>
<tr>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>R. Berndt: Meandering with STM and light</td>
<td>S. Sadewasser: Spatially resolved surface photovoltage spectroscopy</td>
<td></td>
</tr>
<tr>
<td>9:45</td>
<td>J. Aizpurua: Nanooptics in subnanometric gaps: from single molecule imaging to quantum tunneling plasmonics</td>
<td>R. Temirov: How much control over single molecules could we get with the junction of a scanning probe microscope?</td>
<td></td>
</tr>
<tr>
<td>10:30</td>
<td>Coffee Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00</td>
<td>M. Ternes: The mechanical properties of a monoatomic layer investigated by combined STM and AFM measurements</td>
<td>S. Fölsch: Manipulating atoms and molecules on a III-V semiconductor surface by cryogenic STM</td>
<td></td>
</tr>
<tr>
<td>11:45</td>
<td>P. Jelinek: AFM/STM measurements of atomic and molecular contacts</td>
<td>G. Meyer: Scanning probe microscopy of single molecules on insulating films: molecular geometry and intramolecular charge distribution</td>
<td></td>
</tr>
<tr>
<td>12:30</td>
<td>Lunch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td>Registration Welcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:30</td>
<td>F. J. Giessibl: Atomic forces, currents and spins measured by simultaneous STM and AFM</td>
<td>C. Grosse: Exploring luminescence on submolecular length scales and nanosecond time scales</td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>Coffee Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:30</td>
<td>M. Heyde: The Impact of Atomic Force Microscopy and Spectroscopy to Illuminate Complex Oxide Surfaces</td>
<td>J. Repp: Dynamic Force Microscopy and Spectroscopy of Individual Molecules on thin insulating films</td>
<td></td>
</tr>
<tr>
<td>17:15</td>
<td>F. Stavale: Cathodoluminescence spectroscopy using a STM: a powerful tool for nano-oxides characterization</td>
<td>S. Kawai: Mechanical properties of a single long molecular wire</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Z. Majzik: Simultaneous AFM and STM analysis of surface reactions on silicon surfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19:00</td>
<td>Posters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20:00</td>
<td>Snacks and Drinks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dinner</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Oral Presentations:

Monday Afternoon
14:30-15:15 Franz. J. Giessibl
Atomic forces, currents and spins measured by simultaneous STM and AFM
15:15-16:00 Alexander Schwarz
Forces, Tips, Cantilevers and Light
16:30-17:15 Markus Heyde
The Impact of Atomic Force Microscopy and Spectroscopy to Illuminate Complex Oxide Surfaces
17:15-17:35 Fernando Stavale
Cathodoluminescence spectroscopy using a STM: A powerful tool for nano-oxides characterization
17:35-18:00 Zsolt Majzik
Simultaneous AFM and STM analysis of surface reactions on silicon surfaces

Tuesday Morning
9:00-9:45 Richard Berndt
Meandering with STM and light
9:45-10:30 Javier Aizpurua
Nanooptics in subnanometric gaps: from single molecule imaging to quantum tunneling plasmonics
11:00-11:45 Markus Ternes
The mechanical properties of a monoatomic layer investigated by combined STM and AFM measurements
11:45-12:30 Pavel Jelinek
AFM/STM measurements of atomic and molecular contacts

Tuesday Afternoon
14:30-15:15 Christoph Grosse
Exploring luminescence on submolecular length scales and nanosecond time scales
15:15-15:35 Christian Lotze
Fundamental Processes in Single Molecule Junctions: Interplay of Forces and Electronic Effects
15:35-16:00 Jingcheng Li
Tunneling electrons induced light emission in electronic systems
16:30-17:15 Jascha Repp
Dynamic Force Microscopy and Spectroscopy of Individual Molecules on thin insulating films
17:15-18:00 Shigeki Kawai
Mechanical properties of a single long molecular wire

Wednesday Morning
9:00-9:45 Sascha Sadewasser
Spatially resolved surface photovoltage spectroscopy
9:45-10:30 Ruslan Temirov
How much control over single molecules could we get with the junction of a scanning probe microscope?
11:00-11:45 Stefan Fölsch
Manipulating atoms and molecules on a III-V semiconductor surface by cryogenic STM
11:45-12:30 Gerhard Meyer
Scanning probe microscopy of single molecules on insulating films: Molecular geometry and intramolecular charge distribution

Posters:

Gelavizh Ahmadi
Monitoring a ring-closure reaction on the ligand of an Fe-Porphyrin Molecule

Wibke Bronsch
Self-assembling and electronic structure of metallocenes on Pb(111) and Pb(100)

Robert Drost
The interface of graphene with hexagonal boron nitride

Nino Hatter
Diarylethene molecules on a Ag(111) surface: stability and electric field-induced switching of single molecules

Nils Krane
Charge Localization in Merocyanine on Au(111)

Jesús Martínez Blanco
STM light emission from the InAs(111)A surface: First Results

Marten Piantek
Manipulation of the electronic structure in a Ruthenium complex by an STM/AFM tip

Celia Rogero Blanco
Reshaping of Cu(110) by phthalocyanine molecules

Michael Ruby
Electron Momentum Anisotropy in Superconducting Tunnel Junctions

Fabian Schulz
Local doping and lifetime modulation of molecular electronic states on monolayer hexagonal boron nitride

Evan Spadafora
Simultaneous nc-AFM/STM investigation of the B:Si(111)√3×√3 surface

Paul Stoll
Bistable charge states in the acceptor-donor complex Tetracyanoethylene-Tetrathiafulvalene on Au(111)

Martina Svec
Highly ordered silicon triplets within a platinum surface alloy

Tobias Umbach
Charge distribution of alkali-organic monolayers on a metal surface

Ben Warner
Exploring the magnetic properties of metallophthalocyanines on a thin insulator

Ping Yu
Nanoscale photoelectron mapping and spectroscopy with an atomic force microscope

Yang Zechao
Gold-Adatom-Mediated Bonding and Molecular Orbitals of Self-Assembled DCV5T-Me2 Nanostructures on Au(111)
List of Participants:

Gelavizh Ahmadi  Department of Physics, Free University Berlin (Germany)
Javier Aizpurua  Center of Material Physics, San Sebastián (Spain)
Richard Berndt  Institute of Instrumental and Applied Physic University of Kiel (Germany)
Wibke Bronsch  Department of Physics, Free University Berlin (Germany)
Bo Chen  Department of Physics, Free University Berlin (Germany)
Rory Chen  Department of Physics, Free University Berlin (Germany)
Martina Corso  Center of Material Physics, San Sebastián (Spain)
Robert Drost  Department of Applied Physics, Aalto University School of Science (Finland)
Stefan Fölsch  Paul Drude Institut für Festkörper Elektronik, Berlin (Germany)
Isabel Fernandez Torrente  Department of Physics, Free University Berlin (Germany)
Katharina Franke  Department of Physics, Free University Berlin (Germany)
Lukas Gerhard  Karlsruhe Institute of Technology (Germany)
Franz J. Giessibl  Department of Physics, University of Regensburg (Germany)
Toby Gill  London Center for Nanotechnology (UK)
Christoph Grosse  Max Plank Institute for Solid State Research, Stuttgart (Germany)
Nino Hatter  Department of Physics, Free University Berlin (Germany)
Benjamin Heinrich  Department of Physics, Free University Berlin (Germany)
Markus Heyde  Fritz-Haber-Institut der Max-Plank-Gesellschaft, Berlin (Germany)
Pavel Jelinek  Institute of Physics of Czech Academy of Science, Prague (Czech Republic)
Shigeki Kawai  Institute of Physics, University of Basel (Switzerland)
Nils Krane  Department of Physics, Free University Berlin (Germany)
Janina Ladenthin  Fritz-Haber-Institut der Max-Plank-Gesellschaft, Berlin (Germany)
Jingcheng Li  CIC-nanoGUNE, San Sebastián (Spain)
Christian Lotze  Department of Physics, Free University Berlin (Germany)
Zsolt Majzik  CIC-nanoGUNE, San Sebastián (Spain)
Jesús Martínez Blanco  Paul Drude Institut für Festkörper Elektronik, Berlin (Germany)
Jose Martinez  Instituto de Nanosciencia de Aragón, Zaragoza (Spain)
Gerhard Meyer  IBM, Zürich (Switzerland)
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. Ignacio Pascual</td>
<td>CIC-nanoGUNE, San Sebastián (Spain)</td>
</tr>
<tr>
<td>Olof Peters</td>
<td>Department of Physics, Free University Berlin (Germany)</td>
</tr>
<tr>
<td>Marten Piantek</td>
<td>Instituto de Nanosciencia de Aragón, Zaragoza (Spain)</td>
</tr>
<tr>
<td>Jascha Repp</td>
<td>Department of Physics, University of Regensburg (Germany)</td>
</tr>
<tr>
<td>Celia Rogero Blanco</td>
<td>Center of Material Physics, San Sebastián (Spain)</td>
</tr>
<tr>
<td>Michael Ruby</td>
<td>Department of Physics, Free University Berlin (Germany)</td>
</tr>
<tr>
<td>Sascha Sadewasser</td>
<td>International Iberian Nanotechnology Laboratory, Braga (Portugal)</td>
</tr>
<tr>
<td>Fabian Schulz</td>
<td>Department of Applied Physics, Aalto University School of Science (Finland)</td>
</tr>
<tr>
<td>Alexander Schwarz</td>
<td>Department of Physics, University of Hamburg (Germany)</td>
</tr>
<tr>
<td>Violeta Simic</td>
<td>SPECS, Berlin (Germany)</td>
</tr>
<tr>
<td>Evan Spadafora</td>
<td>Institute of Physics of Czech Academy of Science, Prague (Czech Republic)</td>
</tr>
<tr>
<td>Fernando Stavale</td>
<td>Brazilian Center for Physics Research, Rio de Janeiro (Brazil)</td>
</tr>
<tr>
<td>Paul Stoll</td>
<td>Department of Physics, Free University Berlin (Germany)</td>
</tr>
<tr>
<td>Martin Svec</td>
<td>Institute of Physics of Czech Academy of Science, Prague (Czech Republic)</td>
</tr>
<tr>
<td>Ruslan Temirov</td>
<td>Forschungszentrum Jülich (Germany)</td>
</tr>
<tr>
<td>Markus Ternes</td>
<td>Max Plank Institute for Solid State Research, Stuttgart (Germany)</td>
</tr>
<tr>
<td>Tobias Umbach</td>
<td>Department of Physics, Free University Berlin (Germany)</td>
</tr>
<tr>
<td>Ben Warner</td>
<td>London Center for Nanotechnology (UK)</td>
</tr>
<tr>
<td>Ping Yu</td>
<td>Department of Physics, University of Regensburg (Germany)</td>
</tr>
<tr>
<td>Yang Zechao</td>
<td>Department of Physics, Free University Berlin (Germany)</td>
</tr>
</tbody>
</table>
Hotel:
Seminaris CampusHotel Berlin
Takustr. 39
14195 Berlin
(next to Department of Physics of Freie Universität Berlin)

Workshop Dinner:

Gasthaus Landauer
Landauer Strasse 8
147197 Berlin

Best way to get there:
U3 from Dahlem Dorf to Rüdesheimer Platz