



Research Projects

TP	Project title	Project leader
A1	Electron-Hole Pairs in Metal Surfaces excited by Chemical Reactions and Inelastic Scattering	H. Nienhaus
A2	The Spectroscopy of Hot Electrons through Chemisorption and Catalytic Reactions at Metallic Surfaces	D. Diesing E. Hasselbrink
A3	The Energy Dissipation of Cold Reactive Particles on Surfaces	J. Berndt D. Diesing J. Winter
A4	Kinetic Energy Transfer Processes at Surfaces	A. Wucher
A6	Interaction of highly charged ions with surfaces	M. Schleberger A. Wucher
B2	The Dynamics of Surface Atoms after Electronic Stimulation	B. Krenzer M. Horn-von Hoegen
B3	The Investigation of Fast Dissipation Processes Using Femtosecond X-ray Spectroscopy	D. von der Linde P. Zhou
B4	Vibrational Excitations and Desorption Dynamics of Photo-stimulated Processes in Adsorbed Layers	E. Hasselbrink
B5	Time-Resolved Photoelectron Microscopy	F. Meyer zu Heringdorf M. Horn-von Hoegen D. von der Linde
C1	Energy Dissipation of Ballistic Injected Electrons	R. Möller A. Lorke
C2	Friction of the Conduction of Electrons at Surfaces	M. Horn-von Hoegen R. Möller G. Dumpich F. Meyer zu Heringdorf
C4	Friction of Single Point Contact	R. Möller
C6	Elektronic Energy Dissipation in small Metallic Structures	M. Schleberger
C7	Theory and Computer Simulation of Friction Phenomena	D. Wolf

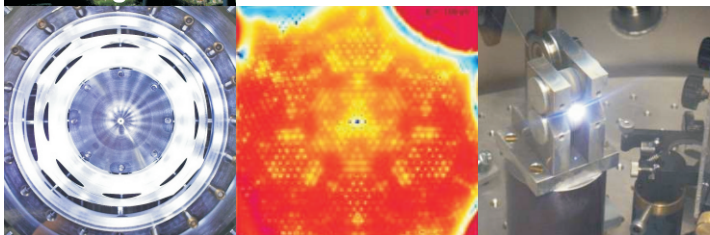
Energy Dissipation at Surfaces

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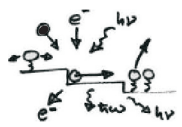
Collaborative Research Centre of the
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<http://www.physik.uni-due.de/sfb616/>

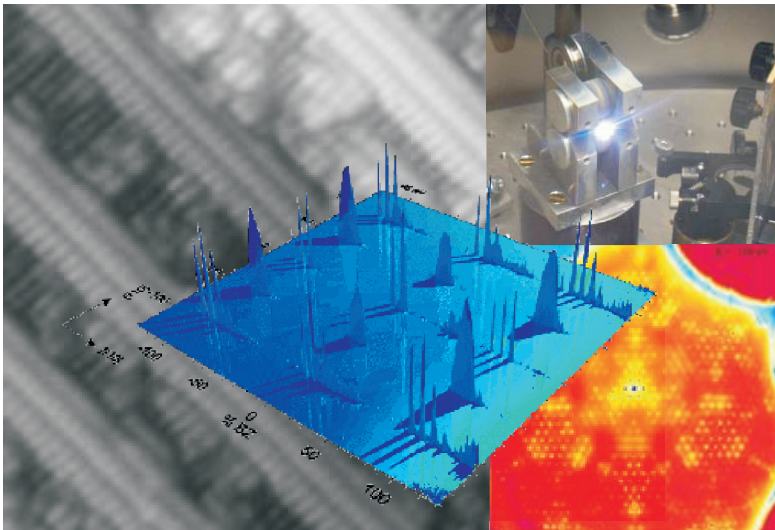


„Energy Dissipation”

The transformation of energy from one form to another form likely happens at surfaces and is renowned as the driving force of many processes in day-to-day life. These processes determine chemical reactions at surfaces and they play an important role both in mechanical friction and in view of the time-limitation of switching processes in modern micro-processors. Energy dissipation also plays an essential role in modern material-processing using intense laser pulses or ion-beam-etching procedures.

Within the SFB 616 the elementary mechanisms of the energy dissipation at surfaces are investigated for selected model-systems. For this, under UHV-conditions well defined clean surfaces are specifically exposed to light, electrons, atoms or atomic clusters, and the respective interaction-effects are studied. During these processes photons, electrons, atoms or ions may be released in turn, which are observed using various spectrometers and microscopes. Moreover, also the time-scale is investigated, along which the energy dissipates into lattice vibrations and finally into heat.

A holistic understanding of the energy dissipation at surfaces yields the basis for the development and optimization of technological applications with respect to life span, efficiency of chemical reactions and the economic usage of various forms of energy.



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Research aims of the SFB 616:

- Electron-electron-coupling, life-time of excited electronic states depending on their energy and position in k-space, thermalizing of the electron system; electron-phonon-coupling
- Life-time of specific vibrational states, coupling-strength between high and low energetic vibrational modes in adsorbates; coupling to the phonon-system of the bulk
- Dynamic of atomic collision cascades and coupling of high-energy atomic motions to electronic degrees of freedom, inverse electron-phonon-coupling
- Nature of mechanical friction, model-system of atomic point-contacts, excitation of electronic- and phonon systems, manipulation of friction through adsorbates
- Localized electronic excitations through adsorption, chemical reaction, neutralization and elektron injection
- Scattering, life-time and mean free path of ballistic hot electrons or holes, respectively
- Interrelation of the surface morphology (adatoms, rough surfaces or volume defects) with the scattering of conduction-electrons regarding surface resistance and electromigration

Highlights:

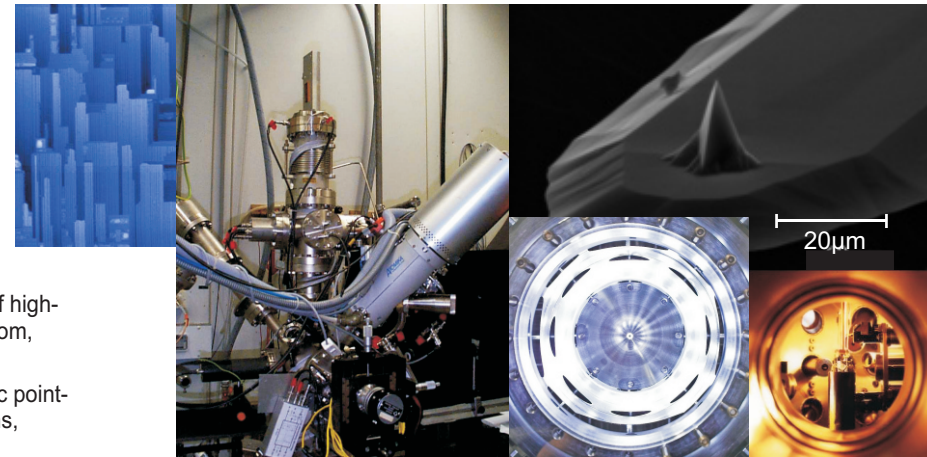
- A picosecond view of melting
(D. von der Linde et al., *Science* **302**, 1345 (2003))
- Frictional coupling between sliding and spinning motion
(Z. Farkas et al., *Phys. Rev. Lett.* **90**, 248302 (2003))
- Continuous Monitoring of Mg Oxidation by Internal Exomission
(S. Glass and H. Nienhaus, *Phys. Rev. Lett.* **93**, 168302 (2004))
- Kinetic electron excitation in atomic collision cascades
(S. Meyer, D. Diesing, A. Wucher, *Phys. Rev. Lett.* **93**, 137601 (2004))
- Dynamics of an Ising chain under local excitation:
An STM study of Si(100) dimer rows at 5K
Y. Pennec, M. Horn von Hoegen, Xiaobin Zhu, D.C. Fortin, and M. R. Freeman, *Phys. Rev. Lett.* **96**, 026102 (2006)

Activities:

- Education of PhD students through special lectures and summer schools
- Seminars and Colloquia on latest topics of the SFB
- Organization of international workshops/symposia
- Consulting on applications regarding surface science, Nanotechnology, thin films and Nano-Materials

For latest news and announcements see:

<http://www.physik.uni-essen.de/sfb616/>



„Energy Dissipation at Surfaces”

This title summarizes the activities of the SFB 616 regarding the processes of energy transformation at surfaces as they play an important role along with chemical reactions in automotive catalysts, during heat-damage of smallest wires in micro-processors or during modern material processing using laser beams. The focus is on the investigation of the elementary processes of these energy dissipation steps under both controlled and easiest possible conditions.

Funding for the SFB 616 through the Deutsche Forschungsgemeinschaft started in July 2002. In June 2005, the second four-year funding period started, with a total budget of 6 Million Euro.

About 60 scientists are working within the SFB 616, 16 of them are young researchers (PhD students and postdocs) supported by research grants from the DFG. The state-of-the-art research infrastructure allows all participating research groups to perform competitive research in areas, which play an essential role in both day-to-day life as well as modern technology and material processing, and which are of ever growing importance specifically in the field of nanotechnology.



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