IAP Seminar

Barbara A.J. Lechner

Technische Universität München, Department Chemie,
Garching/Germany

Tuesday, 8th May 2018, 16:00 s.t.
TU Wien, Institut für Angewandte Physik, E134
1040 Wien, Wiedner Hauptstraße 8-10
Yellow Tower „B“, 5th floor, SEM.R. DB gelb 05 B

Observation of Magnetite Surface Dynamics and Reactivity by FastSTM

A chemical reaction on a catalyst surface is typically a highly dynamic process: reactants are activated on the catalyst particle and can spill over onto the support material, molecules move across the surface, products form and desorb, and the catalyst surface itself can restructure. Thus, the reaction rate is influenced, *e.g.* through mass transport limitations, while the durability of a catalyst depends on the stability of the catalyst particles and support under reaction conditions. We investigate such dynamic phenomena on the magnetite, Fe_3O_4(001), surface using scanning tunneling microscopy (STM).
To obtain a new, in situ, view of dynamic surface processes, we have accelerated our STM to video frame rates [1]. In the case of magnetite [2], we observe mobility of the surface itself at temperatures up to 100°C. Typical surface defects which appear similar topographically in STM can be easily discriminated by their dynamic behavior. We observe facile transport of Fe atoms across and under the surface as well as exchange with the bulk. Domain boundaries become less well defined and dynamic with increasing temperature, until they dissolve during a phase transition [3]. In addition, adsorbates are often mobile on the surface. Interestingly, H adatoms readily jump between two adjacent O atoms of the support [4], but experience a high barrier to lateral diffusion even at 180°C. Finally, we follow surface etching processes under reducing or wet conditions and growth of islands in an oxygen atmosphere.

References

[1] F. Esch, C. Dri, A. Spessot, C. Africh, G. Cautero, D. Giuressi, R. Sergo, R. Tommasini, G. Comelli, *Rev. Sci. Instrum.* **2001**, *82*, 053702.
[2] G. S. Parkinson, *Surf. Sci. Rep.* **2016**, *71*, 272-365.
[3] N. C. Bartelt, S. Nie, E. Starodub, I. Bernal-Villamil, S. Gallego, L. Vergara, K. F. McCarty, J. de la Figuera, *Phys. Rev. B* **2013**, 88.
[4] O. Gamba, J. Hulva, J. Pavelec, R. Bliem, M. Schmid, U. Diebold, G. S. Parkinson, *Top. Catal.* **2017**, *60*, 420-430.

All interested colleagues are welcome to this seminar lecture (45 min. presentation followed by discussion)

Friedrich Aumayr
(LVA-Leiter)

G. Parkinson
(Seminar Chair)