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S E M I N A R
aus
Halbleiterphysik und Nanotechnologie

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"Combined STM/AFM: Opportunities and Challenges on Oxide Surfaces"

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Recent developments of noncontact atomic force microscopy (nc-AFM) have opened new possibilities with a potential impact in many fields: Submolecular resolution of organic molecules [1], controlling the charge state of single atoms [2], or measuring forces involved in a single chemical bond [3]. After a brief introduction into the concepts and challenges of the noncontact AFM, I will focus on possibilities and opportunities that the technique offers in surface science of metal oxides.

The superior atomic resolution of the technique will be illustrated on binary oxides like TiO_2 or In_2O_3. Advantages for studying surface chemistry will be discussed on an example of O_2 adsorption on various TiO_2 surfaces: O_2 plays a key role in catalysis, photocatalysis, or in living systems. The molecule is very sensitive to electron injection (or removal), and its adsorption is therefore difficult to study by STM. AFM offers an intriguing opportunity to inject or remove single electrons at will, and thus understand and modify the molecule's chemical properties [4]. Last, I will show that the combined AFM/STM opens a way towards investigation of more complex materials; this will be illustrated on ternary perovskites $KTaO_3$ and $SrTiO_3$ [5].

[1] Gross, L.; Mohn, F.; Moll, N.; Liljeroth, P.; Meyer, G., *Science* **2009,** *325*, 1110

[2] Gross, L.; Mohn, F.; Liljeroth, P.; Repp, J.; Giessibl, F. J.; Meyer, G., *Science* **2009,** *324*, 1428

[3] Sugimoto, Y.; Pou, P.; Abe, M.; Jelinek, P.; Perez, R.; Morita, S.; Custance, O., *Nature* **2007,** *446*, 64

[4] M. Setvin, J. Hulva, G. S. Parkinson, M. Schmid, U. Diebold, *PNAS* 114, E2556, **2017**

[5] M. Setvin, M. Reticcioli, F. Poelzleitner, J. Hulva, M. Schmid, L. A. Boatner, C. Franchini, U. Diebold, *Science* 359, 572, **2018**