

Carbon structures and oxygen adsorption on palladium nanoparticles characterized by KPFM

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(I) The *adsorption* of atomic or molecular species on metal nanoparticles (NP), (II) the *absorption* of atomic species like carbon, hydrogen or oxygen inside NPs and (III) chemical reactions at NPs are of key interest in heterogeneous catalysis. In most cases, ultra-high vacuum (UHV) based surface science techniques like temperature programmed desorption as well as molecular beam techniques and photoelectron spectroscopy are used to study the above mentioned reactivity related phenomena. However, the phenomena strongly depend on the NP's size and shape so that a specific phenomenon observed by the latter techniques cannot be precisely assigned to one type of NP. A characterization at the single NP level is therefore desired.

A solution is to use Kelvin probe force microscopy (KPFM), which is implemented into noncontact AFM (nc-AFM). Because *adsorbed* or *absorbed* species almost always create a surface dipole, their presence can be directly put into evidence by measuring the change of the NP's work function (WF). This strategy forms the base of the ANR-DFG project REACTIVITY, which has the main object to demonstrate that KPFM can be indeed used as an additional surface science tool in heterogeneous model catalysis.

In this contribution, recent results are shown, which were obtained within the REACTIVITY project at the CINaM institute: in the first part, it is shown that KPFM can reveal several phenomena of carbon *adsorption* and *absorption* at PdNPs, involving subsurface carbon and graphene encapsulated PdNPs (G@PdNPs). In the second part, oxygen adsorption KPFM experiments conducted at *as-prepared* PdNPs and G@PdNPs are presented. Such experiments demonstrate that KPFM can reveal important adsorption characteristics. In the outlook, it will be discussed whether or not KPFM can be used to study chemical reactions at PdNPs. After the contribution, catalysis related challenges, problems and solutions in nc-AFM and KPFM can be discussed.

Références

- [1] Grönbeck, H.; Barth, C. *J. Phys. Chem. C* **2019**, 123, 24615--24625.
- [2] Grönbeck, H.; Barth, C. *J. Phys. Chem. C* **2019**, 123, 4360--4370.