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Tenkých vrstev a nanostruktur

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TÉMA

Electron transfer between TiO_2 surfaces and adsorbed O_2 molecules

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TiO_2 is a prototypical metal oxide used in many applications such as photocatalysis, photoelectrochemical solar cells, and transparent conducting oxides. Two forms of TiO_2 are used industrially – rutile and anatase. Electron transfer between substrate and adsorbed species is a key step in heterogeneous catalysis and photocatalysis. I will focus on activating adsorbed O_2 molecules via an electron transfer from the anatase and rutile TiO_2 substrates. O_2 molecules are inert, mainly due to the triplet spin configuration. They can enter chemical reactions or form chemical bonds after accepting an extra electron. I will show that the corresponding chemical change can be directly visualized by a combined AFM/STM setup. Neutral O_2 molecules only interact weakly with the tip, while negatively charged (O_2)- species readily form chemical bonds. The O_2 molecules are very sensitive to injection and removal of electrons. Their charge state (and chemical reactivity) can be directly manipulated by biasing the tip. This can be either used for switching the O_2 chemical properties, or dissociating the molecule. I will show that illuminating the substrate by UV light induces the same events as observed during the tip-induced manipulations.

Different tip terminations encountered during the measurements will be discussed. Titanium-terminated tips are reactive and provide a direct picture about chemical reactivity of the adsorbed species. Upon picking an O atom or O_2 molecule at the tip apex we obtain tips capable of providing a high spatial resolution. This will be illustrated on imaging different oxide surfaces – TiO_2 anatase, rutile, and In_2O_3.

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