Tuning the Structural and Electronic Properties of TiO_2(110) Surface via Repeated Sputtering and Annealing

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Titanium dioxide is undoubtedly one of the most studied transition metal oxides. This material, also in its crystal form, has a wide variety of applications ranging from photocatalysis, solar cells, memristive devices, sensors to antibacterial films. However, in order to optimize its performance for the most real device implementation, it is crucial to understand the properties of its surface. Hence, a relatively simple model system is essential, namely a well-defined, clean monocrystalline surface. Although there are already well-established methods, including wet and dry etching, sputtering and annealing under various conditions, each of those comes with a certain price to pay.

In the talk we will focus on the standard cleaning procedure consisting of repeated ion beam sputtering and annealing cycles, leading to a clean, (1x1) reconstructed surface, with well-defined terraces. However, both treatments - sputtering and annealing, when used separately, are processes that lead to the reduction of the oxide surface and by changing its stoichiometry results in the modification of its physicochemical properties. The aim of our study is to investigate how these two processes, when used together, affect the electronic properties of the surface and subsurface regions on the nanometer scale. We will show how different might be the properties of the model system depending on the way it is prepared, i.e. how many cycles the surface underwent[1]. For this purpose, local microscopy methods (Kelvin probe force microscopy and contact-mode atomic force microscopy with local conductivity) working in the ultrahigh vacuum conditions were employed. Our study clearly indicates that cleaning cycles affect the electronic properties of TiO_2 surfaces, and that both sputtering and annealing can be used as methods to alter and tailor these properties depending on the required performance.

References:

1. K. Cieslik, D. Wrana, K. Szajna, W. Bełza, M. Rogala, C. Rodenbucher, P. Dabczynski, K. Szot, F. Krok, Appl. Surf. Sci. *under revision*.