Redox reactions studies on SnO_2 and Pd/SnO_2 nanoparticles on $TiO_2(110)$ surface in methanol at near-ambient pressures

O. Leiko[1], K. Mašek[1], J. Kosto[1], J. Nováková[1]

[1]*Charles University in Prague, Faculty of Mathematics and Physics, Department of Plasma and Surface Science, V Holešovickach 2, 18000, Prague, Czech Republic*

leiko.oleksandr@gmail.com

Tin dioxide has been one of the most widely commercially used transparent conductive oxide during last decades. Due to its optical, conductive and catalytic properties and high stability toward aggressive chemical environment it has been used in range of electronic applications and catalysis.

Real catalytic systems have complex structure and thus it is difficult to completely comprehend processes that occurs on their surfaces. For better insight into catalytic mechanisms on their surface model systems are used. Model system is well-ordered, stoichiometric thin films or nanoparticles which can be precisely described by means of surface science techniques. Chemical reactions on model systems can be used as a benchmark for comparison with the same reaction on real catalytic systems. The main problem in such comparison is compatibility of such results, such as studies on model systems usually occurs at low vacuum conditions and cannot cover all processes that can have place in real conditions.

In this work, we have studied interaction of methanol at near-ambient pressure with tin dioxide model systems in form of nanoparticles with average diameter of 27 nm and (110) crystallographic orientation on rutile surface [1]:

$$SnO_2(110) \parallel TiO_2(110)$$

$$SnO_2[1\text{-}10] \parallel TiO_2[1\text{-}10]$$

Lattice parameters of nanoparticles were deduced from reflection high-energy electron diffraction and confirmed by high-resolution transmission electron microscopy. Usage of the near-ambient pressure X-ray photoelectron spectroscopy facility enabled us to perform operando measruments at 1 mbar pressure of methanol and interval of temperatures from 300 K to 600 K. Methanol exposure was carried out on pure and Pd doped tin dioxide nanoparticles model systems.

Drastic changes of Sn^{4+}/Sn^0 ratio on SnO_2 nanoparticles model systems were observed both after methanol exposure and after Pd doping. Fluctuations of Sn^{4+}/Sn^0 ratio were observed with temperatures enhancements in methanol atmosphere.

References:

[1] Leiko O, Kosto Y, Mašek K, Surf Interface Anal. 2018;1–6.