Gas-sensing properties of metal oxide-based chemiresistors studied by near-ambient pressure XPS

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A laboratory for *in-situ/operando* studies of a gas-solid interface was recently built at the Department of Surface and Plasma Science of Charles University. The primary experimental technique in this laboratory is Near-Ambient Pressure X-ray Photoelectron Spectroscopy (NAP-XPS) which allows the chemical analysis of the surface of solid material, in the presence of a gas or vapor, at pressures in the mbar range. As the information on the chemical state of surface atoms and the presence of adsorbate during exposure to gases is crucial in the field of gas sensors, we established a methodology that included XPS analysis of the sensor surface and measurements of its electrical resistance while controllably exposing it to different gases at high temperatures. The developed method was applied for studying ethanol and NO_2 (reducing and oxidizing agents) sensing mechanisms on several nanostructured chemiresistors (SnO_2, Cu_2O, ZnO, WO_3, and Zn-phthalocyanine-based). The information on the chemical state of surface atoms and the accumulation of different adsorbates during the detection process brought new insight into the existing theories of gas sensing.

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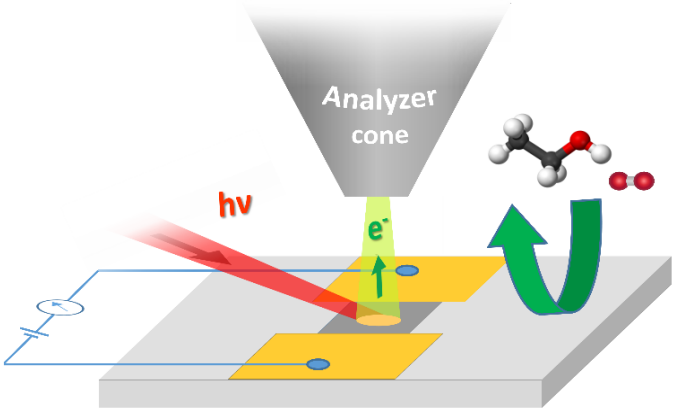

Fig. 1. *In situ/operando* study of gas sensing mechanism by NAP-XPS

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