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NAP-XPS - new end station at SOLARIS synchrotron

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The continuous advancement of X-ray photoelectron spectroscopy (XPS) systems has significantly increased their capabilities far beyond the standard of ultrahigh vacuum (UHV) conditions. As a result, near ambient pressure X-ray photoelectron spectroscopy (NAP-XPS), which allows sample analysis at relatively high pressures in the range of millibars, has become a powerful tool with a wide variety of applications.[1] On the one hand, the NAP-XPS allows to study the unconventional materials, including moderately volatile liquids, biological samples, porous or polymeric materials, which are not UHV compatible. On the other hand, it enables operando investigations of processes occurring at solid-gas, solid-liquid, or liquid-gas interfaces, opening new avenues for research.

A new NAP-XPS end station, designed for studies of solid samples in the presence of a gaseous atmosphere, will be assembled at PHELIX beamline[2] in the SOLARIS facility.[3] PHELIX is a soft X- ray beamline featuring two branches dedicated to complementary photoemission investigations. Currently, only one branch is in operation intended for experiments under UHV conditions. The ongoing development of the beamline covers the second branch construction and its integration with the NAP-XPS system. The NAP-XPS end station will be dedicated to in situ and operando XPS experiments in the presence of a controlled gaseous atmosphere within mbar pressure range as well as under UHV conditions, with the sample heating up to 1000°C. To probe the interfaces between solids and gases at the ambient pressures, the end station will be equipped with an ambient pressure (AP) cell. The solid samples will be placed at the AP cell docked to the electron energy analyser during the experiments, wherein the defined gas will be dosed. The NAP-XPS end station will offer the XPS investigations with high temporal resolution together with simultaneous infrared reflection absorption spectroscopy measurements and analysis of the outlet gas composition by mass spectrometry. Such combination of experimental techniques will allow to follow the chemical reaction and probe the geometrical, chemical, and electronic catalyst structure relate to catalyst function. The first planned user experiments are scheduled for second half of 2027.

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