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Atmospheric Pressure X-ray Photoelectron Spectroscopy for catalysis and electrocatalysis

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The discrepancy between higher operating pressures applied in catalytic processes and lower measurement pressures accessible during surface characterization is known in the community as the “pressure gap”. To bridge this gap, new experimental and instrumental methods have been developed such as Ambient Pressure XPS (AP-XPS), which allows the collection of photoelectrons at pressures in the millibar range. The wealth of information provided by these experimental setups is of prime importance to the understanding of complex systems. However, the study of solid-gas interfaces with partial pressures beyond a few tens of millibars remains a major challenge. Recently, this technique was extended to higher kinetic energy (HAXPES). Notably, this approach combined with a small aperture nozzle increases the operation pressure up to 100 millibars. Here we introduce an atmospheric pressure XP spectroscopy cell based on an array of micro holes coated with graphene that solves the mechanical stability problem of free standing graphene covering large open areas and still provides high transmission for low kinetic energy electrons (higher than 400 eV) combined with a high rate of fabrication reproducibility. We will illustrate the operation of this setup with different examples in liquid and gas phase such as the selective hydrogenation of alkynes into alkenes/alkanes and in the characterization of electrochemical processes on electrified interfaces under aqueous conditions.

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