Atmospheric Pressure X-ray Photoelectron Spectroscopy

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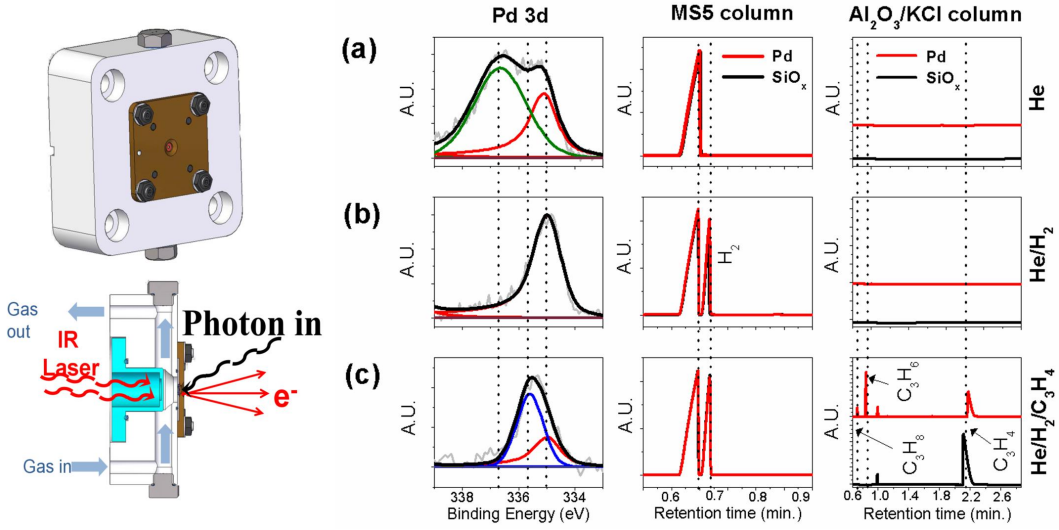
The discrepancy between higher operating pressures applied in catalytic processes and lower measurement pressures accessible during surface characterization is known in the community as the "pressure gap". To bridge this gap, new experimental and instrumental methods have been developed such as Ambient Pressure XPS (AP-XPS), which allows the collection of photoelectrons at pressures in the millibar range. 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 (see Figure) [1] and in the characterization of electrochemical processes on electrified interfaces under aqueous conditions [2].



Pd 3d XP spectra and gas chromatography traces (VARIAN μGC 4900) using a mol sieve MS5 column (VARIAN CP740148) and Al_2O_3/KCl column(AGILENT 494001440) : a) He, b) He/H_2, and c) He/H_2/C_3H_4 gas mixtures.

References

[1] J. J. Velasco-Vélez et al., Rev. Of Sci. Ins.**87(5)**, 053121 (2016).

[2] J. J. Velasco-Vélez et al., Ang. Chem. Int. Edit. **54(48)**, 14554-14558 (2015).