Liquid-Jet Velocity-Map Photoelectron Imaging

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ABSTRACT

Volatile liquid-jet photoelectron spectroscopy (LJ-PES) enables direct studies of the electronic structure of solutes and common solvents and has greatly enhanced our understanding of electron energetics and scattering phenomena in both bulk and interfacial liquid-phase environments.[1,2] To date, such measurements have been performed with hemispherical or time-of-flight-based electron analysers, respectively suffering from low-electron-collection efficiencies or insensitivity to electron angular distributions. As commonly demonstrated with gas-phase samples, the velocity-map imaging technique offers ultimate electron collection efficiency, simultaneous spectral and angular distribution measurements, and down to few-percent energy resolutions for tens-to-hundreds of eV electron kinetic energies. However, thus far, velocity-map photoelectron imaging conditions have generally been deemed or found to be incompatible with volatile-liquid sample environments.

Here, we present pioneering soft X-ray liquid-jet velocity-map photoelectron imaging results, as generated from liquid-microjet targets and allowing simultaneous and optimal measurements of liquid-interface electron energetics, state symmetries, and electron-scattering distributions. Exemplary results will be presented for organic solvents, liquid water, and select aqueous solutions. Associated data-processing challenges, further instrument developments, and some of the unique applications of the newly developed instrument will also be described.

REFERENCES

1. S. Thürmer, S. Malerz, F. Trinter, U. Hergenhahn, C. Lee, D. M. Neumark, G. Meijer, B. Winter, and I. Wilkinson, *Chem. Sci.*, **12**, 10558-10582 (2021)

2. B. Winter, S. Thürmer, and I. Wilkinson, *Acc. Chem. Res.*, **56**, 77–85 (2023)