Contribution ID: **27** Type: **Invited Oral**

VUV Sources for Time-Resolved Gas and Solution Phase Photoelectron Spectroscopy

Thursday 2 May 2019 12:00 (30 minutes)

Time-resolved photoelectron spectroscopy (TR-PES) is a powerful tool for examining the photoinduced dynamics of molecules in the gas or solution phase.[1] However, to fully exploit the power of TR-PES for unravelling complex photochemical reactions, it is necessary to have probe photons of sufficiently high energy, capable of ionising the system of interest over the full range of the potential energy surface sampled after photoexcitation. Given that many small molecules have ionisation energies in excess of 10 eV, VUV sources provide the ideal energy range for TR-PES studies of such systems.

While recent advances in filamentation four-wave mixing[2] and high-harmonic generation (HHG) have made it possible to realise such experiments in a tabletop format, they are often hampered by issues including poor flux. The greater brilliance of advanced light sources addresses some of these issues but there are few facilities capable of producing ultrafast pulses in this energy range. I will present the results of two studies in the gas and solution phase in the context of how the proposed ELBE parameters could have facilitated or improved such experiments. The first study concerns the investigation of gas-phase ring-opening reactions with TR-PES at the FERMI FERMI free-electron laser and the second utilises a liquid microjet to use TR-PES to investigate solution-phase energy transfer processes, performed at our in-house HHG facility, HARMONIUM.[3]

1. T. Suzuki, Int. Rev. Phys. Chem., 2012, 31, 265–318.
2. T. Horio et al., Opt. Express, 2013, 21, 22423–22428.
3. C. Arrell et al., Chim. Int. J. Chem., 2017, 71, 268–272.

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Track Classification: VUV FEL applications