

7th World Congress on

Mass Spectrometry

June 20-22, 2018 | Rome, Italy

Multiplexed synchrotron photoionization mass spectrometry: Characterization of combustion and atmospheric reactions

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Synchrotron multiplexed photoionization mass spectrometry has proven to be a powerful and reliable experimental technique to probe precise reactions relevant to both combustion and atmospheric chemistry by characterizing products and intermediates, energetically via photoionization spectra and kinetically via time traces. The versatility of a side-sample flow tube reactor employing flash photolysis initiation of the reactions has been satisfactorily proven in recent years. The continuously tunable synchrotron radiation is employed as the photoionization source. The synchrotron multiplexed photoionization mass spectrometer at the advanced light source (ALS) of Lawrence Berkeley National Laboratory will be described and specific examples will be presented. As a result of the multiplexing capabilities of this apparatus, each set of data comprises a three-dimensional data block of time, mass-to-charge ratio, and photon energy as function of ion intensity. The reaction is initiated when the photolysis laser is fired, i.e., this corresponds to the reaction starting time t_0 . The species generated in the reactions can be followed in time and energy to provide kinetic traces and photoionization (PI) spectra, which is a plot of the ion signal of a chosen mass-to-charge ratio versus the photon energy. The PI plots are of great importance in product identification because each species has specific Franck-Condon factors that translate into different shapes of the photoionization spectra. In addition, photoionization spectra not only assist in product identification, but also provide information relating to the relative concentrations of products of interest through the measurement of their photoionization cross-sections.

Biography

Giovanni Meloni is a Professor, Chemistry Department Chair and a Physical Chemist. Prior to joining the University of San Francisco, he carried out Post-doctoral research at the University of California, Berkeley and at Sandia National Laboratories. In this research, he used state-of-the-art techniques, both experimental and computational, to study transition states, semiconductor clusters, and van der Waals species employing anion photoelectron spectroscopy, and hydrocarbon radicals using pulsed-laser photolytic initiation and continuous-laser absorption detection. His current research interests range from high-temperature physical chemistry to spectroscopic characterization of reaction intermediates important to atmospheric and combustion chemistry, especially focusing on biofuel molecules.

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