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PHOTOELECTRON SPECTROSCOPY OF RADICALS OF ASTROCHEMICAL INTEREST

M. DRISSI[1], G.A. GARCIA[1], L. NAHON[1], S. BOYE-PERONNE[2], B. GANS[2], H.R. HRODMARSSON[3], H.L. Le[2], M.-X. JIANG[2] and J.-C. LOISON[4]

[1]*Synchrotron SOLEIL, L'Orme des Merisiers, Saint-Aubin, Gif sur Yvette, France*
E-mail myriam.drissi@synchrotron-soleil.fr
[2]*ISMO, CNRS, Université Paris-Saclay, 91405 Orsay, France*
[3]*LISA, Campus centre de l'UPEC, 61 avenue du Général de Gaulle, 94010 Créteil Cedex, France, France*
[4]*ISM, CNRS, Univ. Bordeaux, 351 cours de la Libération, Talence, 33400, France*

Abstract. The modelling of astrochemical media requires the characterization of thousands of physical and chemical processes. In this type of media, radicals and ions are known to be important drivers of chemistry (Smith, 2011). Their identification and characterization are therefore necessary to gain knowledge on these processes. Vacuum-ultraviolet (VUV) photoionization can be used, not only to characterize the electronic structure of molecules through photoelectron spectroscopy, but also to study their photochemistry under VUV irradiation. Additionally, in the past decade, synchrotron-based photoelectron spectroscopy has been coupled to mass spectrometry in search of a universal detection method able to probe the presence of products and intermediates in complex chemical reactions (Krüger et al., 2014), or to prepare a reactant in a given internal state prior to reaction (Ascenzi et al., 2019). Among the different types of species detected in space, sulfur bearing molecules have gained attention over the past years due to difficulties matching the detected abundances with chemical models, which highlights the importance of studying the processes in which they are involved. Here I will present the VUV photoionization of key sulfur radical molecules such as the linear sulfur carbon chains HCCS and CCS which may be precursors of polycyclic sulfur bearing molecules, or the SiS radical which is thought to play a role in the formation of sulfide grains. I will show how these highly reactive and therefore elusive species are produced within a MW discharge flowtube reactor (Garcia et al., 2015), and its coupling to the synchrotron radiation from the DESIRS VUV beamline (synchrotron SOLEIL, France), and a i^{2}PEPICO (double imaging photoelectron photoion coincidence) spectrometer to measure mass-selected photoelectron spectra with vibrational resolution, which might then be used as a molecular fingerprint to detect these species in terrestrial experiments via advanced mass spectrometry, or as a starting point to record laser-based rotationally resolved photoelectron spectra that can be used to detect cationic species in space.

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