A method to determine the energy-transfer distribution in ion-molecule collisions via PEPICO experiments: the case of glycine

J. Chiarinelli*[§], P. Bolognesi*[1], A. Domaracka[‡2], P. Rousseau[‡], R. Richter[†] and L. Avaldi*

[*] CNR-Istituto di Struttura della Materia, Area della Ricerca di Roma 1, 00015 Monterotondo Scalo, Italy
[§]Dipartimento di Scienze, Università di Roma Tre, Via della Vasca Navale 84, 00146 Roma
[‡]Normandie Université-CIMAP, UMR 6252 CEA/CNRS/ENSICAEN/UNICAEN, BP 5133–14070 Caen Cedex 5, France
† Elettra Sincrotrone Trieste, Area Science Park, Basovizza, Trieste, Italy

Synopsis The ionization and fragmentation of glycine has been investigated by state-selected photoionization experiments. The comparison with the mass spectra from multiply charged ion collisions allows to determine the distribution of the energy deposited in the molecule as a result of the collision.

In a recent work [1] an innovative method has been proposed which, based on the use of state-selected mass spectrometry measured in photoelectron-photoion coincidence (PEPICO) experiments and the comparison with ion collision mass spectra on the same molecular target, provides an estimate of the energy transfer in the ion collision experiment. In this method, the PEPICO spectra are fitted using a constrained linear least-square regression to the ion-induced mass spectrum, considering the most relevant features. The fit parameters represent the contribution of each PEPICO mass spectrum, i.e. the contribution of the fragmentation of a bunch of excited states of the singly charged ion, to the mass spectrum obtained in ion collisions.

The aim of this work on glycine is to fully validate the proposed method and to estimate the energy transfer in ion collisions with different ions (He^{2+}, O^{3+}, O^{6+}, Ar^{11+} and Xe^{25+}) [2], using the mass spectra measured at GANIL.

The PEPICO experiments were performed at the Gas Phase Beamline of Elettra, using the VG+TOF spectrometer endstation, with analyzers placed at the magic angle. The set-up was operated in pulsed extraction mode, triggered either by the detection of a photoelectron or by a random pulse. Thanks to the multichannel capability of the VG analyzer, 5 different kinetic energies are acquired simultaneously. Examples of the PEPICO spectra measured in the valence and inner valence region is reported in figure 1.

The PEPICO spectra in both the valence and inner valence shell show very distinct features with binding energy dependency, revealing that ionized states have a clear state-selective fragmentation.

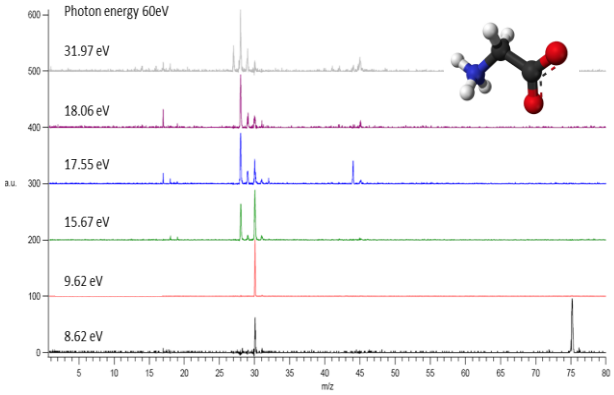

Figure 1. PEPICO spectra of glycine at different binding energies between 8.6 and 32 eV.

The distribution of the energy deposited in the collisions with the multiply charged ions varies with the projectile charge state as the electron capture occurs at different impact parameters. The observed energy dependence in the PEPICO experiments will provide insights on the orbitals involved in the electron capture.

References

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[1] E-mail: Paola.Bolognesi@cnr.it
[2] E-mail: Alicja.Domaracka@ganil.fr