

The stability of hydrogenated PAHs in circumstellar environments

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Polycyclic aromatic hydrocarbons, (PAHs), constituted by benzene rings, as well as hydrogenated PAHs (Hn-PAHs), compounds with excess peripherals H atoms, emit infrared bands (3-12 μm) due to the vibrational transitions. These molecules are present in different astrophysical environments. For example, the band at 3.3 μm , assigned to vibration of aromatic C-H bonds, is generally accompanied by the band at 3.4 μm , assigned to vibration of aliphatic C-H bonds. The abundances of these aromatic and aliphatic molecules in interstellar and circumstellar environments depend on the rates of formation and destruction by UV and X-rays radiation.

We study experimentally the photoionization and photodissociation of hydrogenated Benzene, the Cyclohexane molecule (C_6H_{12}), using synchrotron radiation at UV (10-100 eV) and soft X-ray (280-310 eV) energies and the time-of-flight mass spectrometry. The measurements were performed at Brazilian National Light Synchrotron (LNLS) using the toroidal grating monochromator (TGM) beamline. From the mass spectra of ionic fragments produced by the interaction of photons with the molecule in gas phase, the production for each ion was quantified as a function of the photon energy. Moreover, the stability of the Cyclohexane and Benzene (C_6H_6) molecules was analyzed by the identifications the ions formed

It was observed a greater production of ions such as the ethyl group (C_2H_n^+) and propyl group (C_3H_n^+), products of the photodissociation of C_6H_{12} molecule (fig.1). In addition, we also observed the formation of important ions to circumstellar chemistry, H_3^+ and methyl ion CH_3^+ , possibly by molecular rearrangements. We determined the photon flux as a function of the energy in the photodissociation region (PDR) of the planetary nebula NGC

7027, taking into account the attenuation caused by the H and the dust grains.

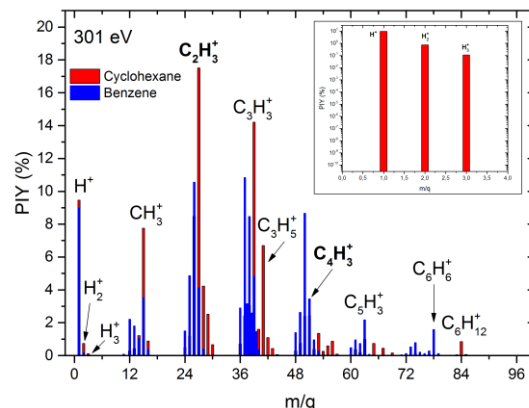


Fig.1. PIYs of the Cyclohexane and Benzene at 310 eV. As insert, PIYs of atomic and molecular hydrogen ions of Cyclohexane are included.

From these photon flux values and the photoionization and photodissociation cross-sections, the ionization and destruction rates of the Cyclohexane and Benzene were determined. We concluded that the aromatic structure is much more stable than the aliphatic structure against UV and X-ray radiation emitted by the central star in photodissociation region of this nebula.

References:

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