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Detection of HCO^+, NO^+, $CNOH^+$ and CH_3^+ by multiphoton dissociation of the Nitromethane

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Synopsis. Using VUV radiation several ionic fragments were observed from the multiphoton dissociation of the Nitromethane. The detection of the molecular ions was focused on: HCO^+, NO^+, $CNOH^+$ and CH_3^+ due to their importance in reactions involving the formation of molecules in the interstellar clouds and the surrounding regions of the stars.

The interaction between the sample of gaseous Nitromethane (CH_3NO_2) with laser light at 532nm and 355nm wavelengths in a multiphotonic absorption regime was perform. The spectra were obtained by TOF in a Reflectron apparatus and at power range of ~10^9-10^{10} W /cm^2.

The attention was focused on the production of HCO^+, NO^+, $CNOH^+$ and CH_3^+ ions for their relevant role in the interstellar reactions involved on molecular clouds, stars and comets [1].

Nitromethane sample was introduced into the ionization chamber through a supersonic expansion process without carrier gas, by a pulsed valve. The sample gas and the laser light interact at 90°. The pressure inside the chamber was around 1x10^{-6} Torr. The formed ions, in the nanosecond regime, were accelerated to the free field region of the R-TOF spectrometer at 1.5 keV maintained at 1x10^{-8} Torr pressure and detected with a microchannel plate and processed with picosecond analyser.

The ions of interest in astrophysics: CH_3^+, $CNOH^+$, COH^+ were detected at both wavelengths with good intensity, increasing with the photon energy and also as a function of the radiation intensity. The fragment NO^+ was identified only at 355 nm. At both wavelengths the parent ion was not detected.

Figure 1 show the TOF spectra for three different radiant energies at 532nm wavelength, where the production of ions with higher m/z ions was favored.

Figure 2 shows TOF spectra at the wavelength of 355nm under the previous experimental conditions. At this photon energy the formation of small m/z ions was favored.

With the results obtained we conclude that the formation of fragment ions came for the process of dissociation - ionization of the Nitromethane and that the production of the selected ions, due to the proximity with its characteristic absorption bands, -198nm and 270nm-[2], were favored at 355nm, and increase with the radiant energy.

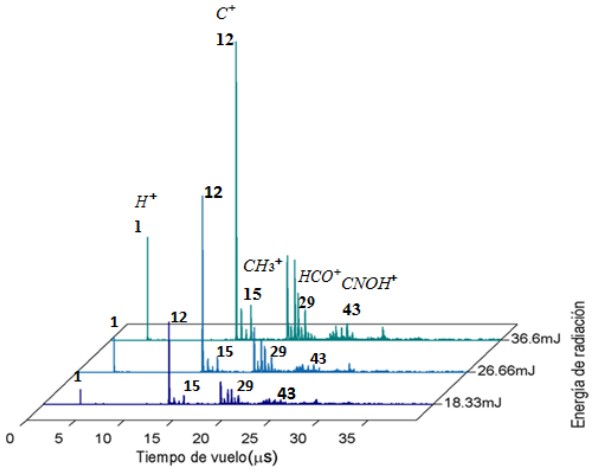

Figure 1. TOF spectra for 532nm at different radiant energies.

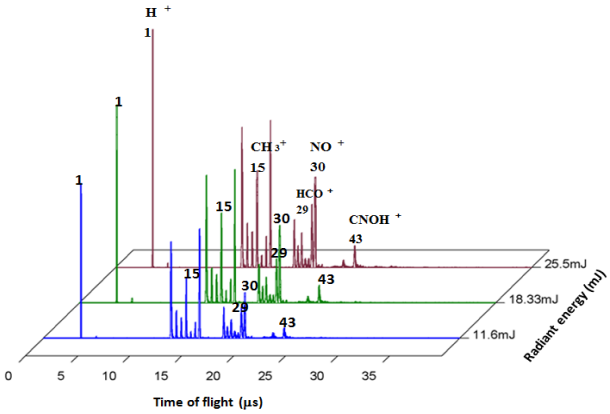

Figure 2. TOF spectra for 355nm at different radiant energies.

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References

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