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Photofragmentation of Formic Acid

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Synopsis Dissociation and ionization of formic acid was investigated by multiphotonic absorption regime using laser pulse at 355nm in conjunction with TOF mass spectrometry in reflectron mode (R-TOF). From the different type of detected fragment ions is inferred the formation of some small clusters of formic acid.

Different ions formation from formic acid (HCOOH) has been previously reported using synchrotron radiation. Experiments from Tabayashi et al. and Arruda et al. reported different ions coming from formic acid clusters [1,2]. Our findings show multiphoton dissociation using laser radiation of 355nm in the range of 10^9-10^{10} W/cm^2 intensity. Mass spectra were obtained using time of flight spectroscopy.

A beam was produced with formic acid 96% pure from Sigma-Aldrich. Two different gases (Argon and Helium) were used as carrier gases in order to investigate the influence of such carrier gases on the ion yield. The beam was collimated with a 0.5 mm skimmer and allowed to enter the main chamber of the apparatus, where it was crossed at 90° with a laser beam of 355nm in the ionization region of the R-TOF mass spectrometer. Ions were accelerated by a constant field of 800 V/cm into the R-TOF spectrometer and detected with a MCP. The signals were digitized and the mass spectra were obtained. Around 35 different ions were identified. Some of the most abundant were H^+, C^+, CH_3^+,H_2O^+, and HCO^+.

Table 1 shows the ion yield values in arbitrary units obtained with different carrier gas. Some ionic fragments included in the graph can only arise from small formic acid clusters.

Table 1. Ionic Yield at 4.11x10^9 W/cm^2.

		Carried gas	
Ion	No gas	Argon	Helium
[a, b, c]H^+	1.11	0.74	2.36
[c]C^+	5.57	4.26	5.74
[a, c]CH_3^+	0.75	0.59	1.03
[a, b, c]H_2O^+	0.25	0.19	0.77
[a, b, c]HCO^+	2.85	2.15	6.38
[c]$[CO_2H_2]H_2^+$	0.05	0.02	0.11

[a]Ions reported in [1], [b]Ions reported in [2] and [c]Ions reported in our work.

From Table 1, it is possible to observe the influence of the carrier gas which is not very evident when synchrotron radiation is used.

It can be concluded that the appearance of ions with mass/charge ratio of 15 and 48 can be explained as they are formed from parent molecular clusters. Such ions can be identified as a characteristics of proton transfer reactions within the clusters.

Figure 1 shows the dependence between the relative intensity and the radiant energy for some of the resulting ionic fragments listed in Table 1.

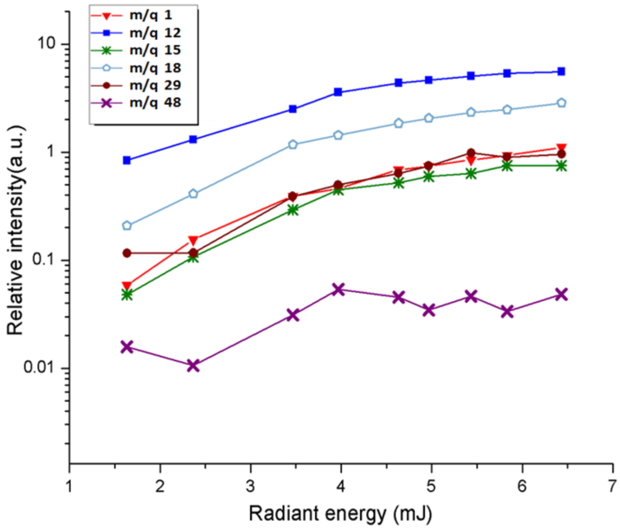

Figure 1. Relative intensity as a function of the radiant energy, the box in the graph related a symbol/color with the m/q ratio.

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References

[1] Kiyohiko Tabayashi *et al* 2006 *J. Chem. Phys.* **125** 194307

[2] Manuela S. Arruda *et al* 2012 *J. Phys. Chem. A* **116** 6693-67

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