

Protonated and deprotonated cluster ions emitted from liquid microdroplets induced by MeV-energy ion irradiation

K. Kitajima¹, T. Majima², Y. Oonishi¹, H. Tsuchida², and A. Itoh^{1,2}

¹ Department of Nuclear Engineering, Kyoto University, Japan

² Quantum Science and Engineering Center, Kyoto University, Japan

kitajima.kensei.33c@st.kyoto-u.ac.jp

Initial processes of reactions between MeV-energy ions and liquids have an important role to understand biological effects at a molecular level in living cells. So far, the early stage of physicochemical processes in liquids is still unclear because of the difficulty in the direct measurement of the complex radiation products formed in the reactions. Recently, we have developed an experimental system to irradiate liquid droplets with MeV-ions under vacuum [1]. The system allows us to perform secondary ion mass spectrometry of liquids to analyze reaction products from liquid targets. In particular, new insights on product ions within a picosecond timescale are expected since the secondary ion emission will occur on this timescale. In this work, we show protonated and deprotonated cluster ions produced from ethanol microdroplets by MeV-ion irradiation.

The experiment was performed by using a 2MV tandem type Pelletron accelerator at Quantum Science and Engineering Center, Kyoto University. We observed protonated and deprotonated cluster ions are emitted from the ethanol droplets with the cluster size at most around ten. As shown in Fig.1, relative intensities of protonated or deprotonated cluster ions decrease exponentially with the cluster sizes. Moreover, the intensities of positive ions are higher than those of negative ions by a factor of 1.6-3.0. Protonated and deprotonated ions can be produced in pair via the proton transfer process in liquid ethanol. The difference in production yield might be due to a positive charge effect by secondary electron emission from the surface.

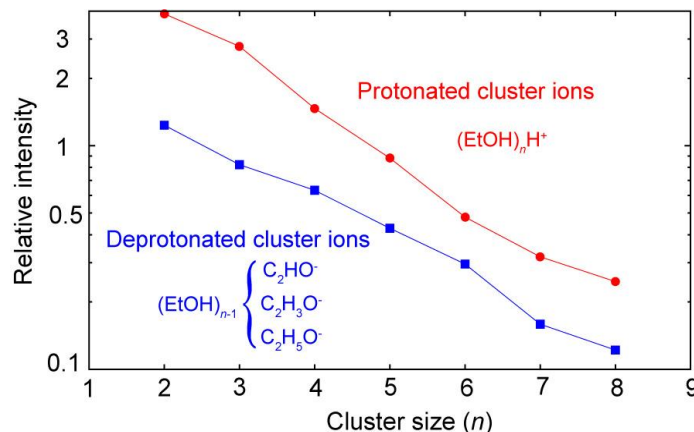


Figure 1: Relative intensities of protonated and deprotonated cluster ions emitted from ethanol droplets induced by 2-MeV C^{2+} ions.

[1] T. Majima, K. Kitajima, T. Nishio, H. Tsuchida, A. Itoh, J. Phys. Conf. Ser, 635 (2015) 012021.