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2020

An, S., Kim, D., & Kim, S. K. (2020). Cryogenic anion photoelectron spectroscopy apparatus with filament ionizer using velocity map imaging. Proc. Of the 7th Asian Spectroscopy Conference (ASC 2020). doi:10.32655/ASC_8-10_Dec2020.54

<https://hdl.handle.net/10356/144315>

https://doi.org/10.32655/ASC_8-10_Dec2020.54

Cryogenic Anion Photoelectron Spectroscopy Apparatus with Filament ionizer using Velocity Map Imaging

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Abstract

The new design of the spectroscopy apparatus for cryogenic anion photoelectron spectroscopy consists of velocity map imaging (VMI) and filament ionization source as described in Figure.1.

Quadrupole mass filter delivers mass-selected ions into a copper quadrupole ion trap (QIT) that is cryogenically cooled by a closed-cycle cryostat. Especially, copper QIT has a better ability to decrease the temperature of ions trapped compared to normal QIT made from stainless steel.^[3] The improved cooling efficiency of copper QIT makes ions not to excite to vibrational state, so it enables us to observe vibration-controlled reaction dynamics. A cryogenically cooled ion packet is extracted from QIT and travels in the Wiley-McLaren time of flight (TOF) region. Both deflectors and einzel lenses fix the turned beam before entering the VMI region.

Also, SIMION simulation provides proper electrostatic ion optics and predicts the ion pathway. Based on the simulation, we optimized this described design for increasing the number of focused ions in the interaction region. By using the above system, we obtained a mass spectrum confirming that the TOF system operates well to perform a further experiment.

Figure 1: Apparatus for cryogenic anion photoelectron spectroscopy.

Keywords: Anion Photoelectron Spectroscopy, Velocity Map Imaging, Time-resolved photoelectron spectroscopy

References:

- [1] A. T. J. B. Eppink and D. H. Parker, “Velocity map imaging of ions and electrons using electrostatic lenses: Application in photoelectron and photo fragment ion imaging of molecular oxygen,” *Rev. Sci. Instrum.*, 68, 3477 (1997).
- [2] Etienne Garand, “Slow photoelectron imaging and infrared dissociation spectroscopy of ionic clusters,” *Ph.D. thesis, University of California, Berkeley*, (2010)
- [3] Shun-ichi Ishiuchi, Masaaki Fujii, “High-cooling-efficiency cryogenic quadrupole ion trap and UV-UV hole burning spectroscopy of protonated tyrosine”, *Journal of Molecular Spectroscopy*, (2017).
- [4] SimIon 8.0 scientific instrument services inc.