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14. ABSTRACT Construction of the slow photoelectron velocity-map imaging (SEVI) instrument was completed and the first results were obtained, demonstrating the power of the technique in measuring high resolution (~0.5 meV) photodetachment spectra of negative ions. Work is continuing on improving the performance of this instrument, with particular focus on reducing stray magnetic fields in the detection region and modifying the ion source and mass spectrometer to achieve higher ion signal and stability.					
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FINAL TECHNICAL REPORT

TITLE: Zero Electron Kinetic Energy/Velocity Map Imaging (ZEKE/VMI) Spectroscopy of Negative Ions

PRINCIPAL INVESTIGATOR: Daniel M. Neumark

DATE: 05/01/03 – 07/31/04

GRANT NO: F49620-03-0261 03-1-0261

SENIOR RESEARCH PERSONNEL: none, other than Principal Investigator

JUNIOR RESEARCH PERSONNEL: Art Bragg, AnnElise Faulhaber, Michael Ferguson, Scott Goncher, Aster Kammrath, Katherine Kautzman, Jeong Hyun Kim, Giovanni Meloni, Matt Nee, Andreas Osterwalder, Darcy Peterka, Sean Sheehan, Niels Sveum, David Szpunar, Jan Verlet, Chia Wang, Jia Zhou

Abstract:

Construction of the slow photoelectron velocity-map imaging (SEVI) instrument was completed and the first results were obtained, demonstrating the power of the technique in measuring high resolution (~ 0.5 meV) photodetachment spectra of negative ions. Work is continuing on improving the performance of this instrument, with particular focus on reducing stray magnetic fields in the detection region and modifying the ion source and mass spectrometer to achieve higher ion signal and stability.

Final Technical Report:

The SEVI instrument was used to obtain high resolution photodetachment spectra of I^- , $\text{I}^-(\text{CO}_2)$, and $\text{Cl}\cdot\text{D}_2^-$. The SEVI spectra of I^- and $\text{I}^-(\text{CO}_2)$ served as test systems, since these ions were studied earlier in our group using anion zero electron kinetic energy (ZEKE) spectroscopy. The SEVI spectra were of comparable resolution but data acquisition times were improved by about a factor of 100. The $\text{Cl}\cdot\text{D}_2^-$ SEVI spectrum showed partially resolved structure corresponding to a progression in the hindered rotor levels of the $\text{Cl}\cdot\text{D}_2$ van der Waals complex, a result of considerable interest in fundamental reaction dynamics owing to the importance of this complex in the $\text{Cl} + \text{D}_2$ reaction. Preliminary results on the SEVI spectrum of the methoxide anion (CH_3O^-) show newly resolved structure owing to the interplay of spin-orbit and Jahn-Teller effects in the CH_3O radical that were not seen in conventional photoelectron spectra of this anion.

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Publications

A. Osterwalder, M. J. Nee, J. Zhou and D. M. Neumark, "High resolution photodetachment spectroscopy of negative ions via slow photoelectron imaging," J. Chem. Phys. 121, 6317 (2004).

Interactions

Gordon Research Conference, Oxford University
Oxford, London
September 18-25, 2003

New Frontiers in Chemical Dynamics and Femtochemistry
The University of York, Department of Chemistry
Heslington York YO10 5DD
October 25 – 30, 2003

XIVth Symposium on Atomic, Cluster and Surface Physics
La Thuile
Aosta, Italy
January 2 – 6, 2004

227th ACS National Meeting
Anaheim, CA
March 28 – April 1, 2004

AFOSR Molecular Dynamics Contractors' Meeting
New Port, Rhode Island
May 24 –26, 2004

DICP Symposium on Molecular Dynamics
Dalian, Liaoning
P. R. China
July 21-23, 2004