Electron-transfer studies in potassium collisions with tetrachloromethane

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Synopsis We have studied electron transfer process in collisions of neutral tetrachloromethane molecular beam and potassium atom beam yielding negative ion formation. The fragment anions formed in this collision process have been assigned and compared against previously reported DEA (dissociative electron attachment) measurements.

Tetrachloromethane, CCl_4, has been widely used as a chemical cleaning agent, in polymerization processes as well as a feed gas in plasma processing. CCl_4 has also been widely used in research investigations due to its high cross section for electron attachment (*s*-wave) at virtually no electron energy, i.e. a shape resonance at ~ 0 eV [1,2], well-attuned to set the electron energy scale and energy resolution in such experiments.

The experimental setup consists of a crossed molecular beam experiment with two chambers (more details were given in Ref. [3]): one where the neutral K beam is produced in a charge exchange chamber and the second where the collision with the molecular target beam takes place. Anionic products formed after electron transfer process from K to the target molecule are extracted and mass analysed into a reflectron time-of-flight (TOF) spectrometer.

We report here time-of-flight mass spectra of anions formed in collisions of potassium atoms with tetrachloromethane molecules as a function of the lab frame collision energy. A TOF mass spectrum at 200 eV is shown in Figure 1. The most relevant fragment anions produced are: Cl^-, Cl_2^-, CCl_2^- and CCl_3^-. The dominant fragment anion, Cl^-, appears also in DEA [1,4] experiments, where its formation requires breaking a single bond.

We performed measurements at different collision energies and found that signal intensity is higher at lower collision energies. This is reminiscent of longer collision times which allows delaying autodetachment in detriment to dissociation. Such is only possible due to the stabilizing nature of the potassium cation in the vicinity of the temporary negative ion. Other fragment anions are considerably less intense, which we also found in DEA experiments [1,4].

Currently, we are working on the implementation of a K^+ beam energy loss analyser, which will give us valuable information on the accessed resonant states of the target molecules.

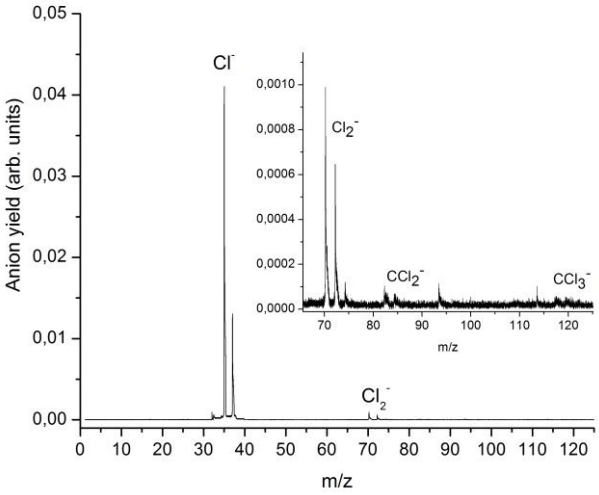

Figure 1. TOF mass spectrum of negative ion formation in K/ CCl_4 electron transfer collisions at 200 eV lab frame.

Further details will be given at the meeting.

References

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