Electron Interactions with Doped Neon Clusters

Rebecca Meißner*†[1], Georg Alexander Holzer*, Michael Neustetter*, Anita Ribar*, Stephan Denifl*[2]

* Institut für Ionenphysik und Angewandte Physik, Universität Innsbruck, A-6020 Innsbruck, Austria
† CEFITEC, Departamento de Física, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829- 516 Caparica, Portugal

The study of positive and negative ion formation in doped inert gas clusters opens a door to further insights into cluster properties. This includes for example in electron attachment the stabilisation of the parent anion by the cluster environment. Furthermore, the understanding of the electron attachment process itself can be extended to the low temperature range. Here, a study of neon clusters doped with CO_2 is presented and compared to earlier results for pure CO_2 clusters and helium droplets doped with CO_2.

Atomic and molecular cluster matrices differ strongly in their characteristics such as temperature and phase. Studies of neutral helium clusters revealed a fluid up to an even superfluid behaviour independently of the degree of doping [1]. In contrast, neon and hydrogen clusters change from a fluid-like to a solid-like behaviour after the embedment of already a few dopants [2].

Besides their differences, all (semi-) fluid, extremely cold (0.4-10K) rare gas clusters share two main similarities. Firstly, a repulsive force towards an excess electron raises an electron bubble in which the charge is localised and thus the electron travels around the cluster [3]. Secondly, the cluster surface represents an electric barrier for an incoming electron, requiring enough kinetic energy of the electron to overcome it.

Electron attachment to doped clusters extends the knowledge of the process itself to the very low temperature range. Besides solvation, temperature can be an important factor in the efficiency of the process and the formation of fragments. Additionally, the cluster environment stabilises otherwise unstable anions formed upon electron attachment. Thus, specific cluster characteristics can be studied [4].

In the current setup, neon clusters are doped with CO_2. Carbon dioxide is a fundamental molecule and electron attachment has already been studied in gas phase, in pure CO_2 cluster beams and in helium droplets [5]. This allows the comparison of stable anion formation among them and provides first hints to the energy barrier for an electron entering the neon cluster.

The experimental setup comprises a high resolution hemispherical electron monochromator, a cluster source, a quadrupole mass analyser and a channeltron detector. The cluster source is based on the principle of supersonic expansion, using a 10µm pinhole nozzle cooled to 65-100K and an expansion pressure of around 20bar. Results of positive and negative ion formation were obtained and will be presented in the frame of this conference.

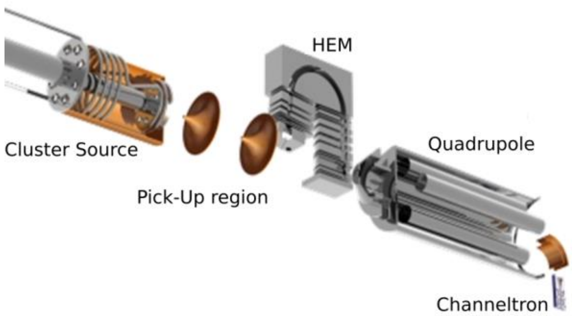

Figure 1. Schematics of the experimental setup.

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[1] E-mail: rebecca.meissner@uibk.ac.at

[2] E-mail: stephan.denifl@uibk.ac.at