Detection of Negative Charge Carriers in Superfluid Helium Droplets: The Metastable Anions He^{-*} and He_2^{-*}

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We observed the creation of helium anions upon electron impact on helium nano droplets in three distinct resonances in the energy range of about 22 eV to 25 eV. These energies coincide very well with the resonances for the formation of negatively charged HND reported by Henne and Toennies [1].

The observed resonances were explained by elastic scattering of an electron with a helium atom, exciting the latter into its metastable 2^3S state and leaving behind an electron bubble. However, it now seems more reasonable to explain this behaviour via formation of He^-, which is heliophilic and therefore readily stays inside the droplet.

Moreover, most parent anion formation processes of molecules embedded in HNDs show a "repetition" of low energy resonances around 22 eV which were attributed to ionization by aforementioned electron bubbles until now [2]. However, the new experimental data suggests that this phenomenon can be explained via the formation of He^- and subsequent ionization due to charge transfer.

We can prove the higher mobility of He^- compared to He_2^- by doping the HND with SF_6. While the He_2^- signal is only slightly affected, the He^- yield drops significantly. This can be explained by the ability of He^- to reach the SF_6 molecule, which resides in the center of the droplet, whereas He_2^- is not mobile enough and moreover will stay at the surface of the HND.

The formation process of He^-, its properties and the consequences on the interpretation of previous studies will be presented in this contribution.

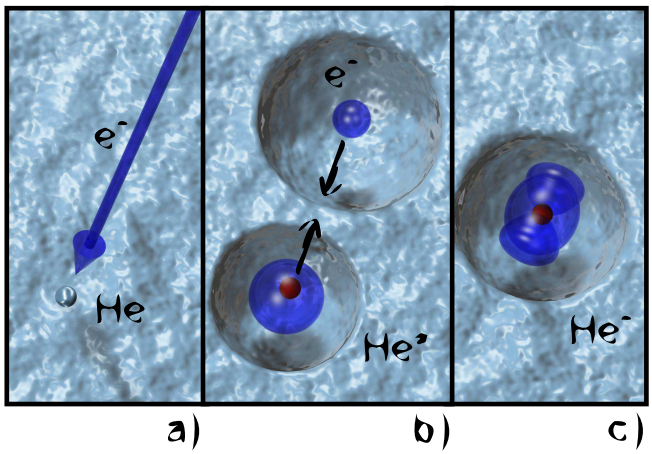

Figure 1: *Artists impression of the creation steps of the helium anion*

References

[1] U. Henne and J. P. Toennies, J. Chem. Phys. 108, 9327 (1998)
[2] S. Denifl et al., Phys. Rev. Lett. 97, 043201 (2006).