Referee report on doctoral thesis of Oldrich Novotný

„Experimental study of electron-ion recombination using storage ring and afterglow techniques“

submitted to Department of Electronics and Vacuum Physics
Faculty of Mathematics and Physics, Charles University in Prague
Referee: Alfonz Luca, PhD.

The submitted doctoral thesis describes studies of electron-ion recombination with different experimental techniques. Recombination rate coefficients of $H_3^+$, $D_3^+$ poly cyclic aromatic hydrocarbons ions, gas hydride ions $ArH^+$, $NeH^+$ and fluorocarbon ions $CF^+$ and $CF_3^+$ have been determined. The recombination of studied ions can play important role in interstellar space and technical plasmas.

The thesis is organized in seven chapters. The first chapter shortly describes different mechanism of recombination processes, the second experimental techniques, measurement procedures, data acquisition and evaluation. Chapter three to six present experimental results and their interpretation. The thesis is summarized in the last chapter.

The author participated in the work in four internationally renowned groups. He learned important experimental techniques for studying ion electron recombination, actively participated in experiments and in development of new apparatus (VT-FALP). He also participated in the development of the new (FLAPI) technique which allows investigations of electron-ion recombination of PAH ions. Obtained results are compared to other experimental and theoretical results and differences are discussed. The main results are published in prestigious journals or are in preparation for publishing.

To my opinion some figures (2.16, 4.3, 4.4, 6.2) present plenty of data points with high fluctuation and partly without any useful information transfer. For example, data in figure 2.16 with laser off could be summarized just by one single number. Additional data processing using averaging or filtering is recommended. There is certainly a mistake in reaction 6.4. The channel B can not be more endothermic than channel C in which fluorine molecule is additionally dissociated.

The inset of Fig. 2.12 should be extended towards smaller masses in order to prove the statement about fragmentation of PAH ions. Non-linear effects like multiple photon absorption could be estimated for the same reason.

The elimination of impurities in complex vacuum apparatuses like FALP is a challenge however necessary, in order to allow studies of certain ions. The background pressure of $\sim 10^{-5}$ Pa in the main chamber results in a similar density of impurities as estimated in chapter 3.3.3 and interpreted by He buffer gas contamination.

Determination of the equilibrium constants, $K_c$, for $D_3^+ / D_3^+$ was not the primary aim of this work. The difference between obtained results in this experiments and published values is explained by the influence of recombination. However, published values fluctuate as well significantly. Therefore I suggest a more detailed data analysis (e.g. using numerical simulation or using regions where the recombination is not dominant) for precise determination of equilibrium constants or its possible systematical deviation. I would expect some statement about recombination coefficient of $D_3^+$ resulting from present measurements.

Mr. Novotný proved by the submitted work ability of independent and creative working and therefore I highly recommend the submitted thesis for its defense.

Chemnitz, 2.2.2006