Topic number: 6

ELECTRON KINETICS IN MIXTURES OF BF_3 AND F_2

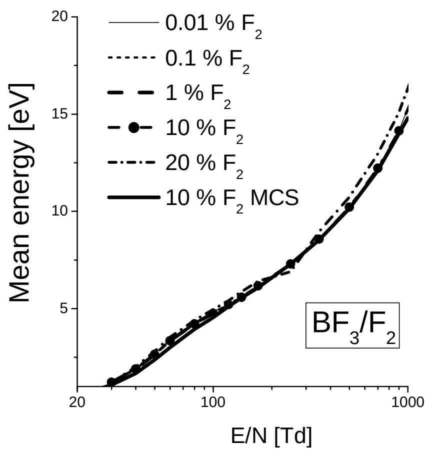
Željka Nikitović(1), Vladimir Stojanović(1), Zoran Lj. Petrović(1)
Uroš Cvelbar(2), Miran Mozetič(2), S. Radovanov(3)

(1)Institute of Physics, Pregrevica 118, 11080 Belgrade, Serbia
(2)Jozef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia
(3)V SEA,35 Dory Road, GL-17, Gloucester, MA01930 USA
zeljka@ipb.ac.rs

The interest in the research of the electron transport phenomena in molecular gases arises from the contribution of electron-assisted processes in modeling phenomena of today's advanced technologies. Understanding electron transport in low temperature BF_3 plasmas [1] is necessary to model ion implantation devices. In particular it has been shown that in gases that have a very large threshold for dissociative attachment it may appear that the discharge would not show electronegative characteristics. However, even small amounts of radicals produced by dissociation of the principal molecule may lead to large attachment at small energies and a large number of negative ions.

In this paper we used the available cross section data (due to S Biagi) [2] for electron impact scattering cross sections for BF_3, F_2 and F [3] to calculate the transport properties for electrons. Often in realistic plasmas, large abundances of fluorine radicals are present, sometimes even at the level of several percent. Cross section sets were compiled and tested against the swarm data and transport coefficients were calculated for DC fields [4].

Monte Carlo simulations (MCS) based on the null collision technique was used to perform calculations of transport coefficients and rate coefficients in DC electric fields. The Monte Carlo code has been verified against basic swarm benchmarks [5, 6]. Calculations were also made by a Two Term approximation (TTA) of the Boltzmann's equation [7].



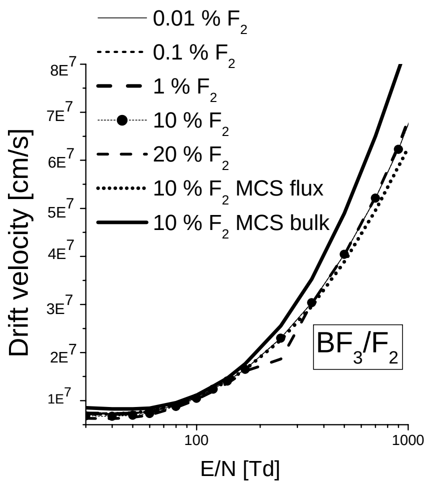


Fig.1: Mean energy and drift velocity in mixture BF_3/F_2.

Electron mean energy and electron drift velocities in mixtures BF_3/F_2 as a function of E/N are shown in Fig.1. Adding 0.01%, 0.1%, 1%, 10% and 20% of radicals does not change significantly the mean energies and shape of drift velocity. Effect of fluorine radicals on drift velocity is the largest in what appears to be a weak indication of a possible plateau that would have developed for stronger inelastic processes (20-80 Td). Adding 10 % or 20 % to F_2 decreases the flux drift velocity by 7.5 % and 15 % respectively. In this region results of MCS are higher than the results for TTA while for higher E/N they are below the TTA in all cases.

In Fig.2 we show total attachment coefficients for mixture BF_3/F_2 as a function of *E/N* accounting for total electron loss in the mixture. Attachment of BF_3 affects electron kinetics from about 100 Td. The effect of radicals on attachment is small at higher *E/N*.

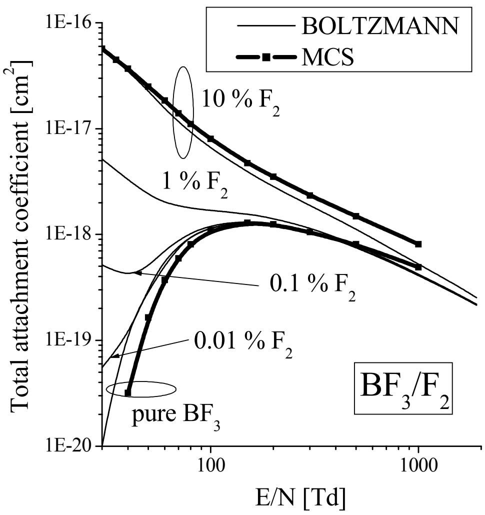


Fig.2: Total attachment coefficients in mixture BF_3/F_2.

Acknowledgements

The work presented here was supported in part by MNTRS 141025 project.

This work was carried out with the support by the MNRS under grant No.141025 and by joint funding from Serbian Ministry and Slovenian Ministry for High Education, Science and Technology (ARRS) grant BI-SRB-SLO-10-11 No.1. Ž.Nikitović expresses special thanks to Slovenian Fund Ad-Futura for postdoc grant.

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