A SET OF CROSS SECTIONS AND TRANSPORT COEFFICIENTS FOR ELECTRONS IN HBr

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In recent years HBr has become one of the key gases in plasma etching technologies [1]. Nevertheless there is a great shortage of data for plasma modeling, including both cross sections and swarm parameters. In the present work, we show compile a set of cross sections based on available theoretical and binary collision data and we proceed to calculate the corresponding transport coefficients.

The momentum transfer cross section was taken from Rescigno [2] and it was extrapolated to lower and higher energies. Rotational excitation was calculated on the basis of Takayanagi formulae. Vibrational excitation and dissociative attachment were taken from Čižek et al. [3]. Electronic excitation to three different states was taken from Rescigno [2] but we have supplemented it by effective total excitation cross section that was developed for HCl by Hayashi [4]. Finally ionization was calculated by Ali and Kim [5].

A Monte Carlo technique [6] was used to obtain transport coefficients for electrons in HBr. The momentum transfer cross section decays slowly with the energy and as it resembles a constant collision frequency cross section the transport coefficients are uneventful.

Data obtained by a two term theory were compared to exact Monte Carlo results. Due to a large vibrational cross section, there is a significant breakdown of the two term approximation (TTA) because of an extremely large vibrational excitation. The most characteristic feature in electron transport is the sudden increase of the D_T/μwhich has also significant nonconservative effects in the same range.

Due to lack of measured transport coefficients it was not possible to provide a unique and very accurate set of cross sections. However, based on the very accurate data for vibrational excitation, for momentum transfer cross section and for ionization cross section together with some reasonable extrapolations we are able to provide a set that will be good enough for modeling mixtures containing smaller amounts of HBr. For an improved set of cross sections it will be required to make measurements of swarm parameters, in particular ionization coefficients. In addition more studies of electronic excitation and dissociation are needed.

Authors are grateful to Y.K.Kim, J.Horáček, M. Allan and T.Makabe for useful suggestions and providing us with data and to project MNZZS 1478 for partial funding.

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