https://doi.org/10.69646/aob241104

Reactive collisions between electrons and molecular cations. Applications in astrophysics and cold plasmas modelling

Pop, N.,[1] Djuissi, E.,[2] Mezei, J.Z.[3] and Schneider, I.F.[2,4]

[1]Dept. of Fundamentals of Physics for Engineers, Politehnica University Timisoara, Romania
[2]Laboratoire Ondes et Milieux Complexes, CNRS, Univ. le Havre Normandie, France
[3]Inst. of Nuclear Research of the Hungarian Academy of Sciences, Debrecen, Hungary
[4]Laboratoire Aimé Cotton, CNRS, ENS Cachan and Univ. Paris-Sud, Orsay, France
E-mail: nicolina.pop@upt.ro

Dissociative recombination (DR) of molecular cations with electrons is a major elementary process in the kinetics and in the energy balance of astrophysical ionized media (supernovae, interstellar molecular clouds, planetary ionospheres), fusion plasmas in the divertor region, hypersonic entry plasmas and in many other cold media of technological interest.

Using Multichannel Quantum Defect Theory (MQDT), cross sections and Maxwell rate coefficients have been obtained for DR and ro-vibrational transition (RVT) as ro-vibrational excitation (RVE, inelastic collisions), ro-vibrational de-excitation (RVdE, super-elastic collisions) of $H2^+$ and HD^+ for numerous ro-vibrational states of the ion. The computational results obtained are in reasonable agreement with experimental data (Motapon et al., 2014; Epée et al., 2016).

A complete set of vibrationally resolved rate coefficients for BeH^+ cation and its isotopomers: BeD^+, BeT^+ reactive collisions with electrons below the ion dissociation threshold has been provided (Niyonzima et al., 2017; Niyonzima et al., 2018; Pop et al., 2021).

The resulting data are useful for the modeling of the kinetics of the Early Universe and of the magnetic-confinement-fusion-edge plasma.

Our previous studies of DR, vibrational excitation/de-excitation and dissociative excitation (DE) of the BeH^+ ion, based on the MQDT, are extended to collision energies above the dissociation threshold (up to 12 eV) by increasing the number of dissociative states for all molecular symmetries (Djuissi et al., 2024).

References

O. Motapon N. Pop, F. Argoubi, J. Zs Mezei, M. D. Epee Epee, A. Faure, M. Telmini, J. Tennyson, and I. F. Schneider, Phys. Rev. A ,2014, 90, 012706-1-012706-9.

M. D. Epée, J. Zs Mezei, O. Motapon, N. Pop, I. F. Schneider, MNRAS, 2016, 455(1), 276-281.

S. Niyonzima, S. Ilie, N. Pop, et al., Atomic Data and Nuclear Data Table, 2017, 115-116, 287-308.

S Niyonzima, N Pop, et.al, Plasma Sources Sci. Technol., 2018, 27, 025015(10pp).

N. Pop, F. Iacob, S. Niyonzima, A. Abdoulanziz, V. Laporta, D. Reiter, I. F. Schneider, aJ. Zs Mezei, Atomic Data and Nuclear Data Table,2021, 139, 101414(27pp).

E. Djuissi, J. Boffelli, R.Hassaine, N. Pop, V.Laporta, K. Chakrabarti, M. Ayouz, A. Bultel, J. Zs. Mezei, I. F Schneider, Physical Chemistry Chemical Physics, 2024, 26, 18311-18320.