Positron Interactions with Hydrocarbon Molecules

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According to Helander and Ward [1], tokamaks could be the largest repositories of positrons made by man. A large number of runaway positrons are produced in tokamak fusion plasma including in JET and JT-60U [1], due to pair production caused by the runaway electrons and background plasma ions and electrons. These positrons will further collide with other molecules present in the system creating a pool of new species. In the present work we have chosen those targets having numerous applications in the field of plasma physics and astrophysics. For example, carbon is one the major element present in the plasma-facing material of almost all modern operating fusion devices. Hence, the chemical erosion caused by plasma-wall interactions produces a wide spectrum of hydrocarbons (from simple to complex) which contaminate the hydrogenic plasma [2,3]. The study of these hydrocarbons helps in plasma diagnostics in the diverter region of magnetically confined high-temperature hydrogen plasma [4]. Moreover, these hydrocarbons are also present in the planetary and cometary atmosphere making these targets important in the field of astrophysics as well [5].

Positron scattering from hydrocarbons namely methane, ethane, ethene, ethyne, propane, propene, propyne and isomers of pentane (n-, iso-, and neo-) are studied in the incident energies from low (~1 eV) to high energies (~5 keV). Various cross sections are calculated under the modified spherical complex optical potential framework [6] and complex scattering potential-ionization contribution method [6]. The cross sections reported are total, elastic, inelastic, positronium formation (Ps), ionization, and total ionization cross section. In some cases, we have also reported momentum transfer cross section. These cross section data constitute one of the fundamental parts of simulation dynamics such as Monte Carlo and EPOTRAN. EPOTRAN simulation deals with the study of positron transport in solids or in biological media [7].

References

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