Electron-impact excitation of Xe^+ and polarization of its subsequent emissions

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Highlights

- There has been recent interest in to carry out the diagnostics of the inert gas plasma through their ionic lines observed in the emitted spectra. For this purpose, the study of electron impact excitations of inert gas atoms and their ions which play dominant role in plasma are needed.

- Xenon is an ideal and preferred propellant for Hall thrusters and ion thrusters. The electron impact xenon and its ions have been found as leading processes in the thruster plasma.

- Except, the few studies on electron excitation of Ar^+ ion, so far, there are no theoretical / experimental studies reported in the literature for electron impact excitation of inert gas Xe^+ ion.

- In the present work, the electron impact excitation of Xe^+ ion has been studied using fully relativistic distorted wave theory from its ground $5p^5$ (J=3/2) state to the different fine structure excited states of $5p^4 6s$, $5p^4 6p$, $5p^4 7s$, $5p^4 7p$, $5p^4 5d$ and $5p^4 6d$ configurations.

- Xe^+ being heavier and having an open shell configuration, the calculation of the wave functions of its bound states and of the incident projectile electron is very difficult and challenging problem. We represented the bound states of Xe^+ through multi-configuration Dirac-Fock wave functions and calculated using the relativistic GRASP2K program while for continuum projectile electron wave functions we solve the Dirac equations numerically.

- The detailed results for electron impact excitation cross-sections and their corresponding excitation rate coefficients are calculated and reported for the applications in the study of xenon embedded plasma.

- For the plasma modelling purposes, the analytic fittings to our all calculated fine structure excitation cross sections are also provided.

- Further, using our calculated magnetic sub-level excitation cross sections for the $5p^4 6s$, $5p^4 7s$, $5p^4 5d$ and $5p^4 6d$ states, the linear polarizations of the photon emissions from these excited states to the ground state are also reported.