Longitudinally Polarized Electron-Induced Ionization of Palladium Atoms: A Relativistic Spin-Asymmetry Study

Munendra Jain[†] and Sheetal Sisodiya

SVKM's NMIMS University, Indore, Madhya Pradesh, India–453112

Palladium (Pd) metal has exceptional catalytic activity and strong atomic-level interactions, making it an attractive candidate for major biomedical applications [1]. Pd atoms, in combination with other ligand molecules, have significant potential for targeted drug delivery and offer significant improvements in drug delivery systems. A docked Pd atom with any protein site can be used as a biomarker for electron microscopy due to the high scattering cross-section for the incident electron beam. Furthermore,a polarised electron beam can reveal many interesting features of the Pd atom-based nano-drug delivery system. The present study reported the spin-polarised scattering cross-section for the Pd atom in the high-energy regime. We have considered a relativistic mathematical treatment using Ehrhardt scattering geometry for inner-shell ionisation of a heavy atom(Pd) [2]. We have calculated a five-fold differential cross-section for a polarised electron beam with up-down asymmetry for k-shell ionisation under the relativistic energy regime (50 keV to 250 keV). The mathematical formulation is derived using a relativistic plane-wave Born approximation with a short-range interaction potential, and the quantum electrodynamics approach is used to account for wavefunction distortion due to the presence of a heavy nucleus. The results obtained for spin-up-spin-down asymmetry provide evidence for the fine-structure effect in the relativistic energy regime. We have observed that the applied mathematical formulation of the present study closely aligns with the experimental results under favourable conditions.

References

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[†]E-mail: munendra.jain@nmims.edu