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Electron-impact ionisation of W^{q+} ions with 1 q 19

Electron-impact ionisation of W^{q+} ions with $1 \leq q \leq 19$

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Synopsis Electron-impact ionisation cross sections of tungsten ions in the energy range from the ionisation threshold to 1000 eV were measured. The experimental cross sections are compared with results from sub-configuration averaged distorted wave calculations. Derived plasma rate coefficients are provided for convenient use in plasma modelling.

Tungsten is considered a suitable material for plasma-facing components in fusion reactors due to its good thermo-mechanical properties and its low sputtering yield, low chemical erosion, low tritium retention and high durability against neutron flux [1]. As these components will be subject to high particle fluxes, tungsten impurities in the fusion plasma cannot be avoided [2]. The tungsten ions are expected to absorb collisional energy of free electrons and emit strongly in the X-ray and EUV energy range [3] which leads to energy loss in the optically thin plasma which cannot reabsorb the radiation. Control and understanding of the conditions in the plasma requires extensive modelling and this, in turn, reliable data on atomic processes. This motivated our present study on electron-impact ionisation of tungsten ions which complements related work on photoionisation [4] and recombination [5] of tungsten ions. We measured absolute cross sections for electron-impact single ionisation of tungsten ions of the charge states 1 to 19 employing the animated-beam technique at the Giessen electron-ion crossed-beams experiment [6, 7]. In addition we performed accompanying sub-configuration averaged distorted wave calculations (SCADW) using the FAC code [8] in order to guide the interpretation of the measured cross sections. For easier access in plasma modelling, plasma rate coefficients are derived from the experimental and theoretical cross sections.

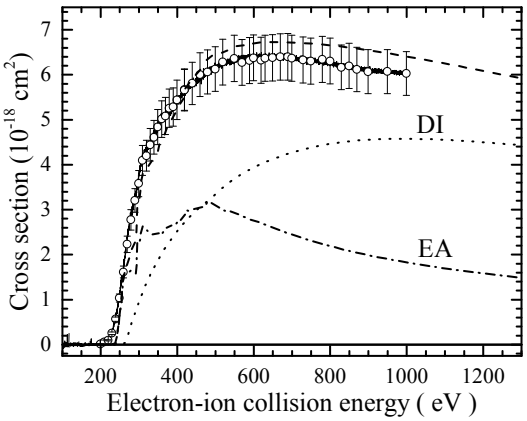

Figure 1. Cross sections for electron-impact single ionisation of W^{12+} ions: Experimental data (solid line, open symbols with quadrature sum of the statistical and systematic uncertainties as error bars) compared to our results of SCADW calculations (dashed line), comprising direct ionisation (DI, dotted line) and excitation autoionisation (EA, dash-dotted line).

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