Theoretical study of electron-impact ionization of W^{25+}

Valdas Jonauskas, Šarūnas Masys and Aušra Kynienė

Vilnius University, Institute of Theoretical Physics and Astronomy,
A. Goštauto 12, Vilnius, Lithuania

Tungsten as facing material in nuclear fusion devices can withstand the high temperatures and heavy bombardments by particles. Nevertheless tungsten penetrates as intrinsic impurity in the thermonuclear plasma. Thus it is up-and-coming to investigate formation of ionized ions due to interaction with electrons.

In this work electron-impact ionization of W^{25+} ion from the ground state has been investigated performing level to level calculations. Theoretical treatment of the ion is complicated by the presence of open f shell. Excitation-autoionization and direct ionization processes are responsible for the formation of ions in the next ionization stage. The direct single ionization and electron-impact excitation cross-sections are obtained in relativistic distorted wave approximation. The calculations are performed using Flexible Atomic Code [1]. Previous investigations [2] using configuration-average model show that radiative damping of excited configurations starts to be important up from W^{45+}. For W^{25+} configuration-average autoionization branching ratios are close to one. Probability to remove an additional electron after electron-impact excitation or ionization due to shake-off process for the highly ionized ions is negligible [3].

Calculated ionization energy of 780.58 eV indicates that excited configurations produced by promotion of electrons from $4s$, $4p$ and deeper shells can decay further through Auger transitions. However excited configurations with the vacancies in $4f$ or $4d$ shells do not reach the ionization threshold. The dominant contribution to the total direct ionization gives $4d$ shell. The ionization cross-section for this shell ($1.6 \cdot 10^{-19}$ cm^2) is about 50 % larger than for $4f$ shell ($9.6 \cdot 10^{-20}$ cm^2) at twice the ionization threshold.

Calculated energy of double ionization equals 1611.19 eV. Only configurations with vacancies in $3d$ or deeper shells have higher energies.

REFERENCES

1. M.F. Gu, *Astrophys. J.* 582, 1241-1250 (2003).
2. S. Loch, J. Ludlow, M. Pindzola, A. Whiteford and D. Griffin, *Physical Review* **A 72**, 1-7 (2005).
3. V. Jonauskas, S. Kučias and R. Karazija, *Lith. J. Phys.* **49**, 415–420 (2009).