

§6. Electron Scattering Cross Sections by Helium and Argon-Critical Evaluations

Hayashi, M. (Gaseous Electronic Inst.)
Tawara, H.

Various electron collision processes with helium atoms and the related cross sections become important in order to understand behavior of plasmas containing alpha particles when DT burning plasmas are achieved. These data for helium atoms are also requisite for basic collision researches as the most fundamental quantity or the standards.

1) Helium data

Since a previous annual report¹⁾, we have tried to improve the accuracies of the evaluated data of total cross sections as well as differential cross sections (DCS) in energy and angle for electron scattering by helium atoms and the excitation of helium atoms through a number of iterations where the DCS integrated over the scattering angle and electron energy should be consistent with the total cross sections which are much more reliable and accurate (with the accuracies of a few %) and under the assumption that all those cross sections should be varied smoothly as a function of the scattering angle or electron energy.

In the present evaluation are given DCS for elastic electron scattering and for electronic excitation of helium into 19 states over the 2^3S - 5^1P states and the (total) integral cross sections for the excitation and ionization (generally 4-5 % accuracies) and also grand total cross sections (1-2 %). As one of the examples of the final evaluated and recommended data, DCS at 200 eV for excitation to the 2^1S state of helium is shown as a function of the electron scattering angle. The solid line represents our recommended differential cross sections (DCS), compared with other experimental data by a number of the authors. These results will be reported in NIFS-DATA report series soon.

2) Argon data

Similar electron scattering data for heavy rare gases and some molecules are useful for modeling and analysis of plasma behavior, in particular for designing radiative gas cooling divertors. A data compilation and their critical evaluation has been already made for argon atoms. A NIFS-DATA report is under preparation

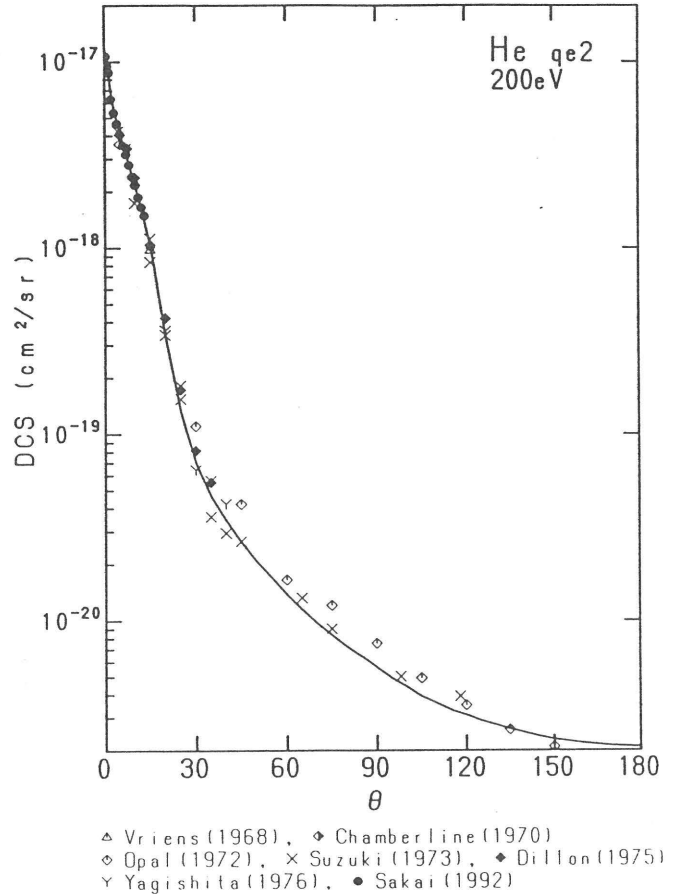


Fig. 1 Differential cross sections of electron scattering at 200 eV for excitation of helium into 2^1S state as a function of the electron scattering angle.

References

- 1) M. Hayashi and H. Tawara, Annual Report (NIFS, 1992-1993) p.193