Electron Interactions With Plasma Reactive Carbon Tetrachloride Molecule: An Extensive Cross Section Study

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Carbon tetrachloride (CCl_4) belongs to the chlorofluoromethanes family, which has multiple industrial applications, but their presence in the upper atmosphere is responsible for the destruction of crucial ozone layer [1]. It is an important etching gas for silicon wafers in microelectronic device fabrication, microelectro-mechanical-systems (MEMS), mass characterization, cleaning surfaces by chemical vapour deposition (CVD) [2], propellants and low temperature plasmas. Debris of these applications and naturally created halomethanes are released to the atmosphere. These by-products are hazardous pollutants with a large residence lifetime in the upper atmosphere and a markedly efficient contribution to the greenhouse effect (GWP 2000) [1,3]. CCl_4 plasmas are frequently used for the etching of Al structures [4,5], but are also used in combination with other gases for the etching of poly-Si, GaAs, Cr/CrO, and Nb [6]. There are also applications of CCl_4 based plasmas for reactive ion etching (RIE) of GaSb and related materials [7].

Reflecting the importance of CCl_4 for various applications, its cross section compilation has been done by G. G. Raju [8] till 2005. The compilation consists of extensive sets of cross sections available at that time. However, the included publications are all more than ten years old, and a considerable number of new cross sections are available now. Considering this aspect, the present report aims to re-examine the available cross sections for CCl_4 and to establish an up-to-date set of recommended cross sections. Cross sections are collected and reviewed for total scattering, elastic scattering, momentum transfer, rotational excitation, dissociation, ionization, and dissociative attachment. Moreover, for each of these processes, the recommended values of the cross sections are derived. The literature has been surveyed till early 2016. These cross sections are a very important piece of information for plasma modellers and hence the present work will be of great significance to the plasma community.

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