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Electron-Driven Ionization of Processing Gases: Status and Perspectives

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In 1985, experimentally determined absolute partial and total electron-impact ionization cross sections for 31 molecules had been reported in the literature [1]. Today, the number of molecules, for which cross sections have been measured, exceeds 100. Experimental ion formation studies have included work involving free radicals and clusters as targets as well as the study of metastable ionic decay routes. Much effort has been devoted to the study of electron-driven ionization of molecules and free radicals of importance top the plasma processing community. These include many halogen-bearing species, but also molecules such as diborane and silane. While a rigorous, fully quantum mechanical theoretical treatment of molecular ionization processes is still impossible (because of the complexity of the ionization process and the complexity of the targets under study), semi-rigorous approaches such as the method of Khare and co-workers, the Binary Encounter Bethe (BEB) approach of Kim and co-workers, and the Deutsch-Märk (DM) formalism (see Ref. [2] for details of these theoretical approaches) have made [2] significant progress. This talk will review recent progress in the experimental (and to a lesser extent theoretical) progress in the field of electron-induced ionization of processing gases. Special emphasis will be placed on recent studies of the electron-impact ionization of Cl-bearing molecules and radicals and the respective role direct vs. indirect ionization processes for these targets. This work was supported by the Chemical Sciences, Geosciences, and Biosciences Division, Office of Basic Energy Sciences, US Department of Energy.

[1] "Electron Impact ionization", T.D. Märk, G.H. Dunn (editors), Springer Verlag: Vienna (1985)
[2] H. Deutsch, K. Becker, S. Matt, and T.D. Märk, Int. J. Mass Spectrom. *197*, 37 (2000)