Electron Collision Cross Sections and Electron Swarm Parameters in Gases

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Electron beam technique and electron swarmtechnique have been used for determining electron collision cross sections foratoms and molecules. It is well known that the advantages and disadvantages ofthe two techniques are almost completely complementary, and close cooperationbetween beam and swarm groups has been urged for better cross section data. Aserious disadvantage of the electron swarm technique is lack of uniqueness ofthe derived cross sections especially when there are more than two competingcollision processes active in the same energy range. Electron swarm parametersin pure molecular gas depend heavily on both momentum transfer cross sectionand vibrational excitation cross sections in low and intermediate range of E/N,where E is the electric field strength and N the gas number density. Whenelectron swarm parameters are measured in gas mixtures which consist of a traceamount of the molecular gas and a rare gas with the Ramsauer-Townsend minimum,they usually show noticeable E/N dependence which depends heavily on themolecular vibrational cross sections and is relatively insensitive to themolecular momentum transfer cross section because of the low molecularconcentration in the mixture. This fact may suggest a possibility of separatedetermination of the momentum and vibrational cross sections of the moleculefrom electron swarm parameters.

An electron swarm study using moleculargas-rare gas mixtures will be reviewed and the advantage of using thesemixtures to evaluate inelastic electron collision cross section data formolecule through electron swarm study is explained. This advantage alsosuggests a new procedure for deriving a consistent set of electron collisioncross sections for molecules by using electron swarm data measured in puremolecular gas and in the molecular gas-rare gas mixtures alternately.