Elecrton Energy Distributions, Vibrational Excitation and Rates of Dissociation in Plasmas of Moderate Pressures

P. Capezzuto, F. Cramarossa, R. d'Agostino and
E. Molinari

Rates of dissociation Of CO_2 and of H_2 have been measured in rf discharges (35 MHz) operated at power levels of 1-10 cal cm^{-3} sec^{-1}, at pressures between 5 and 40 Torr, and with gas flow rates ranging from 0,1 to 60 l(STP)/min. Rates of dissociation by direct electron impact can be calculated from the relevant cross sections once the electron energy distributions are known as a function of the reduced field E/N. Distribution functions for CO_2 are highly non maxwellian while for H_2 a maxwellian distribution can be used as an approximation. Comparison between calculated and observed rates shows that, for both CO_2 and H_2, the ratio between calculated and observed rates is always 1, has a strong negative dependence on pressure and increases with increasing power density. The analysis of these results shows that, with increasing pressure, an increasing fraction of the energy pumped by the rf field into the vibrational systems of these molecules is actually utilized for dissociation according to a mechanism involving vibrorotationally excited CO_2 or H_2.

This mechanism becomes the dominant one at pressures above about 20 Torr, in both cases.

Dr. F. Cramarossa
Centro di Studio per la Chimica dei Plasmi del C.N.R.
Dipartimento di Chimica del Universita
Bari
Italy