

DISSOCIATIVE IONIZATION OF O₂ BY ELECTRON IMPACT

J. SCHOPMAN and R. LOCHT

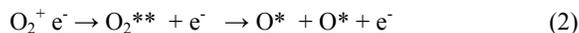
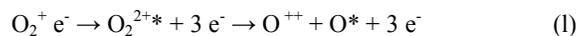
Institut de Chimie, Université de Liege, Sart-Tilman par 4000 Liège I (Belgique)

The dissociative ionization of O₂ has been studied in different ways: photodissociation (1), metastable and high Rydberg dissociation(2) and dissociation by electron impact (3). In spite of the good agreement between the results, some discrepancy remains. This experiment has been made with the apparatus briefly described in the other paper we present (4). The O⁺ ions formed by dissociative ionization of O₂ by electron impact, are analyzed with regard to their kinetic energy. The maxima in the measured energy distributions are given in Table I. This table reproduces also the results of the experiments mentioned above. Quite a good agreement is found for kinetic energies ranging from 0 eV to 5 eV.

Table I : Kinetic energies corresponding to the maxima in the energy distribution of O⁺ from O₂

Photo-dissociation (1)	Metastable and high Rydberg dissociation (2)	Electron Impact (3)	This work
0			0
0.95		0.8	0.79
1.95	1.8 ± 0.3		2.00
3.0	2.9 ± 0.9		2.91
	4.1 ± 0.7		3.82
4.5-5.0	4.2 ± 0.6		4.38
	6.5 ± 0.7		
	6.6 ± 1.0		5.68
	11.1 ± 2.0		(8.3)

At higher energies, however, there is a large discrepancy not only between the positions of the maxima, but also in the relative contributions. Comparing the kinetic energy distributions at electron energies of 35 eV and 60 eV (fig.1) with those measured by metastable and Rydberg dissociation(2), it is evident that the relative contribution of the latter is much larger than in the present electron impact experiment. This fact can be explained by:



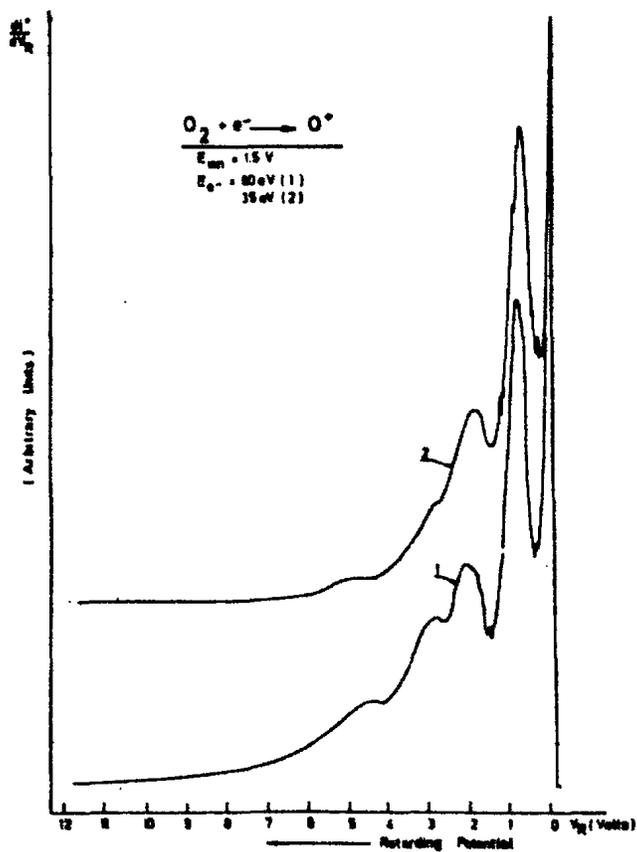
Process(1) can occur at electron energies higher than 40 eV, but it will have a small probability. Moreover the fragments have large kinetic energies making a contribution of process (1) even more improbable. So very high Rydberg states of O₂ would be responsible for the apparent difference in the kinetic energy distributions.

Until now, no structure could be found in the peak at 0.79 eV, which is generally ascribed to a predissociation of the B²Σ_g⁻ state of O₂⁺ to the first dissociation limit (O⁺(⁴S^o) + O(³P)) at 18.73 eV.

In order to identify the (pre)dissociating electronic states of O₂⁺, the appearance potentials of O⁺ have been measured at those kinetic energy values which correspond to each maximum of this distribution.

For processes with a threshold below 34.6 eV, a comparison with the results of the photodissociation helps to identify the states involved.

Fig.1: Kinetic energy distribution of O^+ from dissociative ionization of O_2 by the impact of electrons of 35 eV (2) and 60 eV (1)



References

- 1) P.H.Doolittle, R.I.Schoen, and K.E.Schubert, J.C.P.49 (1968) 5108
- 2) R.S.Freund, J.C.P. 54 (1971) 3125
- 3) L.J.Kieffer, G.M.Lawrence, and J.M.Slater, VII ICPEAC, A'dam (1971)
- 4) R.Locht and J.Schopman. This conference.