SHORT COMMUNICATIONS

Ion Dissociation in a Parabola Mass-spectrogram

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If we ionize some molecules by the electron-impact method, instead of the usual glow-discharge method, in a Thomson's parabola mass-spectrograph, several spots will appear, all of which correspond to the ions deflected to the same degree by the electric field. However, Henglein and Ewald[1] found that secondary spots also appear lying on parabolas and taking the positions of the lower energy side, i. e., on the right side of the vertical line x_0 formed by the primary spots, as shown in Fig. 1. They ascribed the secondary spots to the ion fragments which cracked, flinging themselves between the ionizing and analyzing field, and

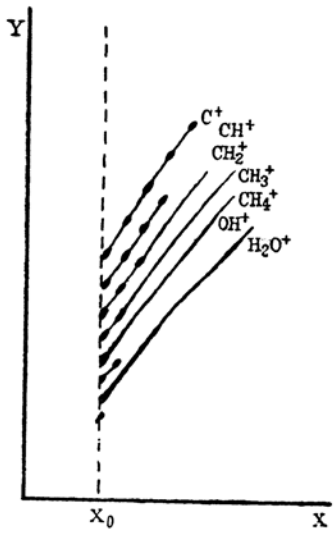


Fig. 1. Ion dissociation; mass-spectrogram of illuminating gas taken by Henglein and Ewald[1].

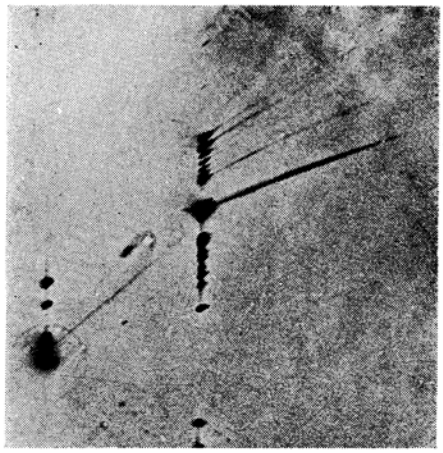
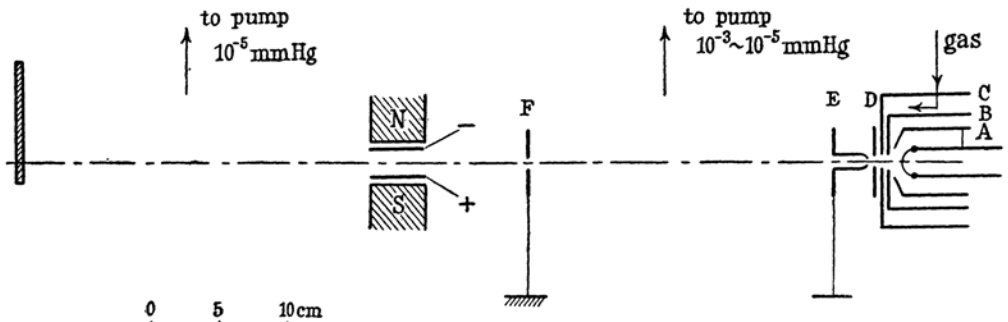


Fig. 3. Acetylene:
Impact electron voltage 200 V,
Ion accelating valtage 7500 V.



S_A	4 mmφ	A ~ B (+)	50 ~ 200 V
S_B	2 〃	B ~ C (−)	4.5 V
S_C	3 〃		
S_D	1 〃	C ~ D (−)	4.5 V
S_E	0.3 〃	D ~ E (−)	0.5 ~ 20 KV
S_F	0.1 〃		

Fig. 2. Scheme of the apparatus.

their energy thus became smaller than that of the primary ions, while their velocity was kept constant.

The authors repeated their experiment, but found slightly different results as will be described.

The ionizing chamber and scheme of the apparatus are shown in Fig. 2, while two examples of the mass-spectrograms taken are shown in Fig. 3 (acetylene) and Fig. 4

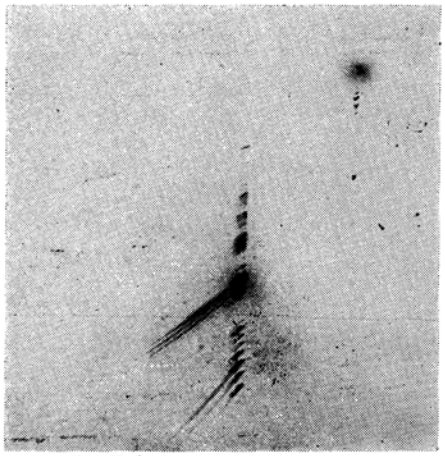


Fig. 4. Ethylene:
Impact electron voltage 100 V,
Ion accelating voltage 7500 V.

ethylene). It will be seen clearly that several spots of secondary ions really appear together with some secondary lines, and that the secondary spots have more prolonged tails than those of Henglein and Ewald. Moreover, our secondary "spots" do not appear in the parabolas whose m/e is 12-15, but the intense ones correspond to m/e=26 ($C_2H_2^+$) in Fig. 3 and to m/e=28 ($C_2H_4^+$) in Fig. 4; they are calculated to be the dissociation fragments of the polymerized acetylene and ethylene ($(C_2H_2)_3^{++} \rightarrow C_2H_2^+$ and $(C_2H_4)_3^{++} \rightarrow C_2H_4^+$, etc.), respectively. Such a result may be due to the difference of the apparatus and, even more, of the experimental conditions. To our regret, owing to the brief description given by Henglein and Ewald, we cannot discuss the real cause of the present discrepancy in detail.

The time of the ions flinging themselves between the ionizing and analyzing field is calculated to be the order of 10^{-7} second, the secondary "spots" being thus produced by the ions cracked within that time. It is smaller by one order of magnitude than the mean life of the metastable ions found by Hipple and others[2].

Detailed studies are going on.

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1) A. Henglein and H. Ewald, "Mass Spectroscopy in Physics Research" (1953), p. 205.
2) J.A. Hipple and E.U. Condon, *Phys. Rev.*, **68**, 54 (1945).