

THE METASTABLE DECOMPOSITION OF METHANE

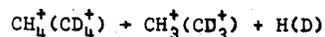
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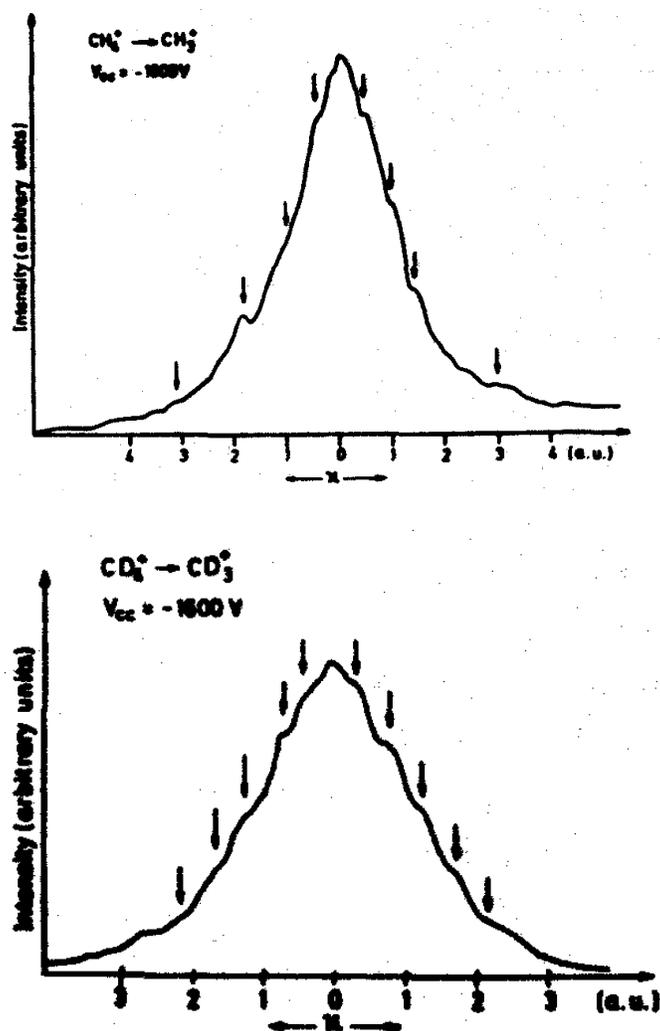
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The metastable decomposition of methane and methane-d₄ through the reaction



has been studied in the first field free region of a AEI MS9 double focusing mass spectrometer (10^{-6} - 10^{-7} s range) (1) and in a tandem mass spectrometer (10^{-5} - 5×10^{-6} s range) equipped with a monoplasmatron (2).

Fig. 1. Momentum distribution of CH_3^+ from CH_4^+ and of CD_3^+ from CD_4^+ in the center of mass, χ is expressed in atomic units (a.u.).



Whereas only a single narrow peak (fwhm = 5 meV) is observed in the former instrument, a structured peak appears in the latter (see fig.1). The kinetic energy release calculated from these peaks are listed in table 1 for both CH_4^+ and CD_4^+ .

Our first results (AEI MS-9) agree with those of SOLKA et al. (3). Those authors suggest a rotational predissociation of the CH_4^+ ions. This interpretation is confirmed in our second experiment by the observation of a broader ro-vibrational structure the origin of which is ascribed to a higher ion source temperature. A semi-classical model is developed to fit the experimental results.

Table 1 : The kinetic energy e_d (in meV) released in the dissociation $\text{CH}_4^+(\text{CD}_4^+) \rightarrow \text{CH}_3^+(\text{CD}_3^+) + \text{H(D)}$.

Peak nb.	e_d in CH_4^+	Peak nb.	e_d in CD_4^+
1	1.7 ± 0.3	1	0.4 ± 0.2
2	5.8 ± 1.0	2	2.7 ± 0.8
3	23.0 ± 4.0	3	6.5 ± 1.2
4	56.0 ± 9.0	4	12.0 ± 2.0
		(5)	20.0 ± 2.7

References

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- (2) J.G. MAAS, N.P.F.B. VAN ASSELT, J. LOS, *Chem.Phys.*, 8 (1975) 37.
- (3) B.H. SOLKA, J.H. BEYNON, R.G. COOKS, *J.Phys.Chem.*, 79 (1975) 859.