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$$C_2H_4^+ + e^- \rightarrow C_2H_3 + H \quad (1a)$$
$$\rightarrow C_2H_2 + H_2 \quad (1b)$$
$$\rightarrow C_2H_2 + 2H \quad (1c)$$
$$\rightarrow C_2H_2 + H_2 + H \quad (1d)$$
$$\rightarrow CH_4 + C \quad (1e)$$
$$\rightarrow CH_3 + CH \quad (1f)$$
$$\rightarrow CH_2 + CH_2 \quad (1g)$$

Thermodynamic Data

$\Delta H^o_{298}(1a) \approx -550$ kJ mol^{-1}

$\Delta H^o_{298}(1b) \approx -838$ kJ mol^{-1}

$\Delta H^o_{298}(1c) \approx -402$ kJ mol^{-1}

$\Delta H^o_{298}(1d) \approx -283$ kJ mol^{-1}

$\Delta H^o_{298}(1e) \approx -424$ kJ mol^{-1}

$\Delta H^o_{298}(1f) \approx -327$ kJ mol^{-1}

$\Delta H^o_{298}(1g) \approx -290$ kJ mol^{-1}

Thermochemical data for all the channels were taken from Ref. [1]. All reactions (1a-g) are highly exoergic, so small errors (by different experimental methods or theoretical approaches) in the formation enthalpies cannot affect the viability of the processes.

Rate Coefficient Data *k*

k / cm^3 molecule^{-1} s^{-1}	T / K	Reference	Comments
Rate Coefficient Measurements			
$5.6 \times 10^{-7}(T/300)^{-0.76}$	20 - 1000	[1]	Storage ring
Rate Coefficient Reviews and Evaluations			
$5.6 \times 10^{-7}(T/300)^{-0.76}$	10 – 300	UMIST database	
$5.6 \times 10^{-7}(T/300)^{-0.76}$		OSU website	
Branching Fraction Measurements			
1(a) = 0.11 ± 0.07		[1]	Storage ring
1(b) = 0.06 ± 0.03			
1(c) = 0.66 ± 0.06			
1(d) = 0.10 ± 0.04			

1(e) = 0.01 ± 0.01

1(f) = 0.02 ± 0.04

1(g) = 0.04 ± 0.02

Branching Fraction Reviews and Evaluations

1(a) = 0.11	10 – 300	OSU website and UMIST database
1(b) = 0.06		
1(c) = 0.66		
1(d) = 0.10		
1(e) = 0.01		
1(f) = 0.02		
1(g) = 0.04		

Comments

To the best of our knowledge the only available measurements of the overall rate and branching fractions of the title reaction has been performed in a storage ring experiment [1]. Flowing afterglow measurements of the dissociative recombination of $C_2H_4^+$ have been hampered by the fact that hydrocarbon ions with even numbers of hydrogen atoms swiftly undergo proton and alkyl transfers with their parent compound [2], e. g.

$$C_2H_4^+ + C_2H_4 \rightarrow C_3H_5^+ + CH_3$$

which makes them unfeasible objects to study in a high pressure regime. We also do not know of any theoretical study of this process.

Preferred Values

Recommended rate constant:
$k = 5.6 \times 10^{-7}(T/300)^{-0.76}$

Recommended branching fractions:
1(a) = 0.34
1(b) = 0.06
1(c) = 0.66
1(d) = 0.10
1(e) = 0.01
1(f) = 0.02
1(g)= 0.01

Comments on Preferred Values
In lack of other data, I recommend the branching fraction and rate constant from the storage ring experiment, which are already used by the models. The overall rate constant appears reasonable for the system and is in line with other hydrocarbon ions. Therefore, there seems to be no reason to change the values already included in the models.

References

[1] A. Ehlerding, F. Hellberg, R. Thomas, S. Kalhori, A. A. Viggiano, S. T.Arnold, M. Larsson and M. af Ugglas, Phys. Chem. Chem. Phys. **6,** 949 (2004)
[2] V. G. Anicich, J. Phys. Chem. Ref. Data, **22,** 1469 (1993)

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