Supporting Information for "Associative electron detachment in sprites"

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Table S1. List of reaction and rate coefficients in our chemical model. In the rate coefficient expressions temperatures are expressed in K, reduced electric fields are expressed in Td and rate coefficients are expressed in m^3s^{-1} for binary reactions and m^6s^{-1} for ternary reactions. T_{eff} is an effective temperature computed from the local electric field and gas temperature (200 K) as explained in the main text. The rate coefficients labelled as "Bolsig+" are electric-field-dependent rates obtained from the solution of the Boltzmann equation with the Bolsig+ solver using Phelp's cross-section database.

	Reaction		Rate ($m^{3(n-1)}s^{-1}$)	Reference
1	$e + N_2$	$\longrightarrow 2e + N_2^+$	Bolsig+	(Lawton & Phelps, 1978; Phelps & Pitchford, 1985; Hagelaar & Pitchford, 2005)
2	$e + O_2$	$\longrightarrow 2e + O_2^+$	Bolsig+	(Lawton & Phelps, 1978; Phelps & Pitchford, 1985; Hagelaar & Pitchford, 2005)
3	$e + O_2 + O_2$	$\longrightarrow O_2^- + O_2$	Bolsig+	(Lawton & Phelps, 1978; Phelps & Pitchford, 1985; Hagelaar & Pitchford, 2005)
4	$e + O_2$	$\longrightarrow O + O^-$	Bolsig+	(Lawton & Phelps, 1978; Phelps & Pitchford, 1985; Hagelaar & Pitchford, 2005)
5	$M + O_2^-$	$\longrightarrow e + O_2 + M$	$k_0 e^{-\left(\frac{a}{b+E/n}\right)^2}$ $k_0 = 1.24 \times 10^{-17}$, $a = 179$, $b = 8.8$	(Pancheshnyi, 2013)
6	$O_2 + O^-$	$\longrightarrow O_2^- + O$	$k_0 e^{-\left(\frac{a}{b+E/n}\right)^2}$ $k_0 = 6.96 \times 10^{-17}$, $a = 198$, $b = 5.6$	(Pancheshnyi, 2013)
7	$N_2 + O^-$	$\longrightarrow e + N_2O$	$4 \times 10^{-17} \times (T_{\mathrm{eff}}/300)^{-1.36} \exp(-5097/T_{\mathrm{eff}})$	(Shuman et al., 2023)
8	$N_2(v_1) + O^-$	$\longrightarrow e + N_2O$	$9 \times 10^{-18} \times (T_{\mathrm{eff}}/300)^{-0.85} \exp(-674/T_{\mathrm{eff}})$	(Shuman et al., 2023)
9	$N_2(v_2) + O^-$	$\longrightarrow e + N_2O$	$2.7 \times 10^{-17} \times (T_{\mathrm{eff}}/300)^{-1.10} \exp(-186/T_{\mathrm{eff}})$	(Shuman et al., 2023)
10	$O_2 + O^- + M$	$\longrightarrow O_3^- + M$	$k_0 e^{-\left(\frac{E/n}{a}\right)^2}$ $k_0 = 1.1 \times 10^{-42}$, $a = 65$	(Pancheshnyi, 2013)

11	$e + N_2$	$\longrightarrow e + N_2(v_1)$	Bolsig+	(Lawton & Phelps, 1978; Phelps & Pitchford, 1985; Hagelaar & Pitchford, 2005)
12	$e + N_2$	$\longrightarrow e + N_2(v_2)$	Bolsig+	(Lawton & Phelps, 1978; Phelps & Pitchford, 1985; Hagelaar & Pitchford, 2005)
13	$e + N_2$	$\longrightarrow e + N_2(v_1)$	Bolsig+	(Lawton & Phelps, 1978; Phelps & Pitchford, 1985; Hagelaar & Pitchford, 2005)
14	$N_2^+ + N_2 + M$	$\longrightarrow N_4^+ + M$	$5 \times 10^{-41} \times (300/T)^3$	(Aleksandrov & Bazelyan, 1999)
15	$N_4^+ + O_2$	$\longrightarrow 2N_2 + O_2^+$	$2.5 \times 10^{-16} \times (300/T)^3$	(Aleksandrov & Bazelyan, 1999)
16	$O_2^+ + O_2 + M$	$\longrightarrow O_4^+ + M$	$2.4 \times 10^{-42} \times (300/T)^3$	(Aleksandrov & Bazelyan, 1999)
17	$e + O_4^+$	$\longrightarrow O_2 + O_2$	Bolsig+	(Kossyi et al., 1992)
18	$A^+ + B^-$	$\longrightarrow$	1×10^{-13}	(Kossyi et al., 1992)

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