Table 1: Considered reactions involving electrons. Rate constants were calculated using Bolsig+ software [**?**]. They are functions of E/N.

	Reactions	Rate constants (cm^3s^{-1} or cm^6s^{-1})	Refs.
R1	$e + N_2 \rightarrow e + N_2(J)$	$f_1(E/N)$	Phelps-0.02eV
R2	$e + N_2 \rightarrow e + N_2(v)$	$f_2(E/N)$	Phelps-$(v_1 - v_8)$
R3	$e + N_2 \rightarrow e + N_2(A_1)$	$f_3(E/N)$	Phelps-6.17eV
R4	$e + N_2 \rightarrow e + N_2(A_2)$	$f_4(E/N)$	Phelps-7.00eV
R5	$e + N_2 \rightarrow e + N_2(B)$	$f_5(E/N)$	Phelps-7.35, 7.36, 7.80, 8.16eV
R6	$e + N_2 \rightarrow e + N_2(a)$	$f_6(E/N)$	Phelps-8.40, 8.55, 8.89eV
R7	$e + N_2 \rightarrow e + N_2(C)$	$f_7(E/N)$	Phelps-11.03eV
R8	$e + N_2 \rightarrow e + N_2(E)$	$f_8(E/N)$	Phelps-11.87, 12.25eV
R9	$e + N_2 \rightarrow e + N(^4S) + N(^2D)$	$f_9(E/N)$	Phelps-13eV
R10	$e + O_2 \rightarrow e + O_2(J)$	$f_{10}(E/N)$	Phelps-0.02eV
R11	$e + O_2 \rightarrow e + O_2(v)$	$f_{11}(E/N)$	Phelps-$(v_1 - v_4)$
R12	$e + O_2 \rightarrow e + O_2(a)$	$f_{12}(E/N)$	Phelps-0.977eV
R13	$e + O_2 \rightarrow e + O_2(b)$	$f_{13}(E/N)$	Phelps-1.627eV
R14	$e + O_2 \rightarrow e + O_2(A)$	$f_{14}(E/N)$	Phelps-4.5eV
R15	$e + O_2 \rightarrow e + O(^3P) + O(^3P)$	$f_{15}(E/N)$	Phelps-6eV
R16	$e + O_2 \rightarrow e + O(^3P) + O(^1D)$	$f_{16}(E/N)$	Phelps-8.4eV
R17	$e + O_2 \rightarrow e + O(^3P) + O(^1S)$	$f_{17}(E/N)$	Phelps-9.97eV
R18	$e + N_2 \rightarrow 2e + N_2^+$	$f_{18}(E/N)$	Phelps-15.6eV
R19	$e + N_2 \rightarrow 2e + N_2^+$	$f_{19}(E/N)$	Phelps-18.8eV
R20	$e + O_2 \rightarrow 2e + O_2^+$	$f_{20}(E/N)$	Phelps-12.06eV
R21	$e + O_2 + O_2 \rightarrow O_2^- + O_2$	$f_{21}(E/N)$	Phelps
R22	$e + O_2 \rightarrow O^- + O(^3P)$	$f_{22}(E/N)$	Phelps

Table 2: Considered reactions involving charged particles. T(K) and T_e(K) are gas and electron temperatures, respectively. T_e(eV) $= K_B$(eV/K) $* T_e$(K) is electron temperature in eV unit.

	Reactions	Rate constants (cm^3s^{-1} or cm^6s^{-1})	Refs.
R23	$e + O_3 + O_2 \rightarrow O_3^- + O_2$	1.00×10^{-31}	[?]
R24	$e + O_3 \rightarrow O_2^- + O(^3P)$	1.00×10^{-9}	[?]
R25	$e + O_3 \rightarrow O^- + O_2$	1.00×10^{-11}	[?]
R26	$e + NO + M \rightarrow NO^- + M$	1.00×10^{-30}	[?]
R27	$e + NO_2 \rightarrow NO_2^-$	3.00×10^{-11}	[?]
R28	$e + NO_2 \rightarrow O^- + NO$	1.00×10^{-11}	[?]
R29	$e + N_2O + N_2 \rightarrow N_2O^- + N_2$	$(4.72(T_e(\text{eV}) + 0.412)^2 - 1.268) \times 10^{-31}$	[?]
R30	$e + O(^3P) + O_2 \rightarrow O_2^- + O(^3P)$	1.00×10^{-31}	[?]
R31	$e + O(^3P) + O_2 \rightarrow O^- + O_2$	1.00×10^{-31}	[?]
R32	$e + O(^3P) + N_2 \rightarrow O^- + N_2$	1.00×10^{-31}	[?]
R33	$O^- + O_2 \rightarrow e + O_3$	5.00×10^{-15}	[?]
R34	$O^- + O_2(a) \rightarrow e + O_3$	3.00×10^{-10}	[?]
R35	$O^- + O_2(b) \rightarrow e + O_2 + O(^3P)$	6.90×10^{-10}	[?]
R36	$O^- + O_3 \rightarrow e + 2O_2$	5.30×10^{-10}	[?]
R37	$O^- + N_2 \rightarrow e + N_2O$	$1.16 \times 10^{-12} \exp(-(\frac{48.9}{11+E/N})^2)$	[?]
R38	$O^- + N_2(A_1) \rightarrow e + N_2 + O(^3P)$	2.20×10^{-9}	[?]
R39	$O^- + N_2(B) \rightarrow e + N_2 + O(^3P)$	1.90×10^{-9}	[?]
R40	$O^- + NO \rightarrow e + NO_2$	2.60×10^{-10}	[?]
R41	$O^- + O(^3P) \rightarrow e + O_2$	5.00×10^{-10}	[?]
R42	$O^- + N(^4S) \rightarrow e + NO$	2.60×10^{-10}	[?]
R43	$O_2^- + M \rightarrow e + O_2 + M$	$1.24 \times 10^{-11} \exp(-(\frac{179}{8.8+E/N})^2)$	[?]
R44	$O_2^- + O_2(a) \rightarrow e + 2O_2$	2.00×10^{-10}	[?]
R45	$O_2^- + O_2(b) \rightarrow e + 2O_2$	3.60×10^{-10}	[?]
R46	$O_2^- + N_2(A_1) \rightarrow e + O_2 + N_2$	2.10×10^{-9}	[?]
R47	$O_2^- + N_2(B) \rightarrow e + O_2 + N_2$	2.50×10^{-9}	[?]
R48	$O_2^- + O(^3P) \rightarrow e + O_3$	1.50×10^{-10}	[?]
R49	$O_2^- + N(^4S) \rightarrow e + NO_2$	5.00×10^{-10}	[?]
R50	$O_3^- + O_3 \rightarrow e + 3O_2$	1.00×10^{-10}	[?]
R51	$O_3^- + O(^3P) \rightarrow e + 2O_2$	3.00×10^{-10}	[?]
R52	$O^- + O_2 + M \rightarrow O_3^- + M$	$1.10 \times 10^{-30} \exp(-(\frac{E/N}{65})^2)$	[?]
R53	$O^- + O_2 \rightarrow O_2^- + O(^3P)$	$6.96 \times 10^{-11} \exp(-(\frac{198}{5.6+E/N})^2)$	[?]
R54	$O^- + O_2(a) \rightarrow O_2^- + O(^3P)$	1.00×10^{-10}	[?]
R55	$O^- + O_3 \rightarrow O_3^- + O(^3P)$	5.30×10^{-10}	[?]
R56	$O^- + NO + M \rightarrow NO_2^- + M$	1.00×10^{-29}	[?]
R57	$O^- + NO_2 \rightarrow NO_2^- + O(^3P)$	1.20×10^{-9}	[?]
R58	$O^- + N_2O \rightarrow NO^- + NO$	2.00×10^{-10}	[?]
R59	$O^- + N_2O \rightarrow N_2O^- + O(^3P)$	2.00×10^{-12}	[?]
R60	$O_2^- + O_2 + M \rightarrow O_4^- + M$	$3.50 \times 10^{-31}(\frac{300}{T})$	[?]
R61	$O_2^- + O_3 \rightarrow O_3^- + O_2$	4.00×10^{-10}	[?]
R62	$O_2^- + NO_2 \rightarrow NO_2^- + O_2$	8.00×10^{-10}	[?]
R63	$O_2^- + NO_3 \rightarrow NO_3^- + O_2$	5.00×10^{-10}	[?]
R64	$O_2^- + N_2O \rightarrow O_3^- + N_2$	1.00×10^{-12}	[?]
R65	$O_2^- + O(^3P) \rightarrow O^- + O_2$	3.30×10^{-10}	[?]
R66	$O_3^- + NO \rightarrow NO_2^- + O_2$	2.60×10^{-12}	[?]
R67	$O_3^- + NO \rightarrow NO_3^- + O(^3P)$	1.00×10^{-11}	[?]
R68	$O_3^- + NO_2 \rightarrow NO_2^- + O_3$	7.00×10^{-10}	[?]
R69	$O_3^- + NO_2 \rightarrow NO_3^- + O_2$	2.00×10^{-11}	[?]
R70	$O_3^- + NO_3 \rightarrow NO_3^- + O_3$	5.00×10^{-10}	[?]
R71	$O_3^- + O(^3P) \rightarrow O_2^- + O_2$	3.20×10^{-10}	[?]
R72	$O_4^- + M \rightarrow O_2^- + O_2 + M$	$1.00 \times 10^{-10} \exp(\frac{-1044}{T})$	[?]
R73	$O_4^- + O_2(a) \rightarrow O_2^- + 2O_2$	1.00×10^{-10}	[?]
R74	$O_4^- + O_2(b) \rightarrow O_2^- + 2O_2$	1.00×10^{-10}	[?]
R75	$O_4^- + NO \rightarrow NO_3^- + O_2$	2.50×10^{-10}	[?]
R76	$O_4^- + O(^3P) \rightarrow O^- + 2O_2$	3.00×10^{-10}	[?]
R77	$O_4^- + O(^3P) \rightarrow O_3^- + O_2$	4.00×10^{-10}	[?]

Table 2: (continued)

	Reactions	Rate constants (cm^3s^{-1} or cm^6s^{-1})	Refs.
R78	$N_2^+ + O_2 \rightarrow O_2^+ + N_2$	$6.00 \times 10^{-11}(\frac{300}{T})^{0.5}$	[?]
R79	$N_2^+ + O_2 \rightarrow NO^+ + NO$	1.00×10^{-17}	[?]
R80	$N_2^+ + O_3 \rightarrow O_2^+ + N_2 + O(^3P)$	1.00×10^{-10}	[?]
R81	$N_2^+ + N_2 + M \rightarrow N_4^+ + M$	$5.20 \times 10^{-29}(\frac{300}{T})^{2.2}$	[?]
R82	$N_2^+ + N_2(A_1) \rightarrow N_3^+ + N(^4S)$	3.00×10^{-10}	[?]
R83	$N_2^+ + NO \rightarrow NO^+ + N_2$	3.30×10^{-10}	[?]
R84	$N_2^+ + NO_2 \rightarrow NO_2^+ + N_2$	3.00×10^{-10}	[?]
R85	$N_2^+ + N_2O \rightarrow NO^+ + N_2 + N(^4S)$	4.00×10^{-10}	[?]
R86	$N_2^+ + N_2O \rightarrow N_2O^+ + N_2$	5.00×10^{-10}	[?]
R87	$N_2^+ + O(^3P) \rightarrow O^+ + N_2$	$1.00 \times 10^{-11}(\frac{300}{T})^{0.2}$	[?]
R88	$N_2^+ + O(^3P) \rightarrow NO^+ + N(^4S)$	$1.30 \times 10^{-10}(\frac{300}{T})^{0.5}$	[?]
R89	$N_2^+ + N(^4S) + M \rightarrow N_3^+ + M$	$9.00 \times 10^{-30} \exp(\frac{400}{T})$	[?]
R90	$N_2^+ + N(^4S) \rightarrow N^+ + N_2$	$2.40 \times 10^{-15}T$	[?]
R91	$N_4^+ + O_2 \rightarrow O_2^+ + 2N_2$	2.50×10^{-10}	[?]
R92	$N_4^+ + N_2 \rightarrow N_2^+ + 2N_2$	$10^{-14.6+0.0036(T-300)}$	[?]
R93	$N_4^+ + NO \rightarrow NO^+ + 2N_2$	4.00×10^{-10}	[?]
R94	$N_4^+ + O(^3P) \rightarrow O^+ + 2N_2$	2.50×10^{-10}	[?]
R95	$N_4^+ + N(^4S) \rightarrow N^+ + 2N_2$	1.00×10^{-11}	[?]
R96	$O_2^+ + O_2 + M \rightarrow O_4^+ + M$	$2.40 \times 10^{-30}(\frac{300}{T})^{3.2}$	[?]
R97	$O_2^+ + N_2 + N_2 \rightarrow N_2O_2^+ + N_2$	$9.00 \times 10^{-31}(\frac{300}{T})^{2}$	[?]
R98	$O_2^+ + N_2 \rightarrow NO^+ + NO$	1.00×10^{-17}	[?]
R99	$O_2^+ + NO \rightarrow NO^+ + O_2$	4.40×10^{-10}	[?]
R100	$O_2^+ + NO_2 \rightarrow NO^+ + O_3$	1.00×10^{-11}	[?]
R101	$O_2^+ + NO_2 \rightarrow NO_2^+ + O_2$	6.60×10^{-10}	[?]
R102	$O_2^+ + N(^4S) \rightarrow NO^+ + O(^3P)$	1.20×10^{-10}	[?]
R103	$O_4^+ + O_2 \rightarrow O_2^+ + 2O_2$	$3.30 \times 10^{-6}(\frac{300}{T})^{4} \exp(\frac{-5030}{T})$	[?]
R104	$O_4^+ + O_2(a) \rightarrow O_2^+ + 2O_2$	1.00×10^{-10}	[?]
R105	$O_4^+ + O_2(b) \rightarrow O_2^+ + 2O_2$	1.00×10^{-10}	[?]
R106	$O_4^+ + N_2 \rightarrow N_2O_2^+ + O_2$	$4.61 \times 10^{-12}(\frac{T}{300})^{2.5} \exp(\frac{-2650}{T})$	[?]
R107	$O_4^+ + NO \rightarrow NO^+ + 2O_2$	1.00×10^{-10}	[?]
R108	$O_4^+ + NO_2 \rightarrow NO_2^+ + 2O_2$	3.00×10^{-10}	[?]
R109	$O_4^+ + O(^3P) \rightarrow O_2^+ + O_3$	3.00×10^{-10}	[?]
R110	$N_2O_2^+ + O_2 \rightarrow O_4^+ + N_2$	1.00×10^{-9}	[?]
R111	$N_2O_2^+ + N_2 \rightarrow O_2^+ + 2N_2$	$1.10 \times 10^{-6}(\frac{300}{T})^{5.3} \exp(\frac{-2357}{T})$	[?]
R112	$e + N_2^+ + M \rightarrow N_2 + M$	$6.00 \times 10^{-27}(\frac{300}{T_e})^{1.5}$	[?]
R113	$e + N_2^+ \rightarrow N_2$	1.50×10^{-7}	[?]
R114	$e + N_2^+ \rightarrow N(^4S) + N(^4S)$	$2.80 \times 10^{-7}(\frac{300}{T_e})^{0.5}$	[?]
R115	$e + N_2^+ \rightarrow N(^4S) + N(^2D)$	$2.00 \times 10^{-7}(\frac{300}{T_e})^{0.5}$	[?]
R116	$e + N_4^+ \rightarrow N_2 + N_2(C)$	$2.00 \times 10^{-6}(\frac{300}{T_e})^{0.5}$	[?]
R117	$e + N_4^+ \rightarrow N_2 + 2N(^4S)$	$3.02 \times 10^{-8}(\frac{300}{T_e})^{0.41}$	[?]
R118	$e + O_2^+ + M \rightarrow O_2 + M$	$6.00 \times 10^{-27}(\frac{300}{T_e})^{1.5}$	[?]
R119	$e + O_2^+ \rightarrow O_2$	1.50×10^{-7}	[?]
R120	$e + O_2^+ \rightarrow O(^3P) + O(^3P)$	$2.40 \times 10^{-7}(\frac{300}{T_e})^{0.7}$	[?]
R121	$e + O_2^+ \rightarrow O(^3P) + O(^1D)$	$1.95 \times 10^{-7}(\frac{300}{T_e})^{0.7}$	[?]
R122	$e + O_4^+ \rightarrow 2O_2$	$1.40 \times 10^{-6}(\frac{300}{T_e})^{0.5}$	[?]
R123	$e + O_4^+ \rightarrow O_2 + 2O(^3P)$	$4.20 \times 10^{-6}(\frac{300}{T_e})^{0.48}$	[?]
R124	$e + N_2O_2^+ \rightarrow N_2 + O_2$	$1.30 \times 10^{-6}(\frac{300}{T_e})^{0.5}$	[?]

Table 2: (continued)

	Reactions	Rate constants (cm^3s^{-1} or cm^6s^{-1})	Refs.
R125	$N_2^+ + O^- + M \rightarrow N_2O + M$	$2.00 \times 10^{-25}(\frac{300}{T})^{2.5}$	[?]
R126	$N_2^+ + O^- + M \rightarrow N_2 + O(^3P) + M$	$2.00 \times 10^{-25}(\frac{300}{T})^{2.5}$	[?]
R127	$N_2^+ + O^- \rightarrow N_2 + O(^3P)$	$2.00 \times 10^{-7}(\frac{300}{T})^{0.5}$	[?]
R128	$N_2^+ + O^- \rightarrow 2N(^4S) + O(^3P)$	1.00×10^{-7}	[?]
R129	$N_2^+ + O_2^- + M \rightarrow N_2 + O_2 + M$	$2.00 \times 10^{-25}(\frac{300}{T})^{2.5}$	[?]
R130	$N_2^+ + O_2^- \rightarrow N_2 + O_2$	$2.00 \times 10^{-7}(\frac{300}{T})^{0.5}$	[?]
R131	$N_2^+ + O_2^- \rightarrow O_2 + 2N(^4S)$	1.00×10^{-7}	[?]
R132	$N_2^+ + O_3^- \rightarrow N_2 + O_3$	$2.00 \times 10^{-7}(\frac{300}{T})^{0.5}$	[?]
R133	$N_2^+ + O_3^- \rightarrow O_3 + 2N(^4S)$	1.00×10^{-7}	[?]
R134	$N_2^+ + O_3^- \rightarrow N_2O + O_2$	7.80×10^{-6}	[?]
R135	$N_2^+ + O_4^- \rightarrow N_2 + 2O_2$	1.00×10^{-7}	[?]
R136	$N_4^+ + O^- \rightarrow 2N_2 + O(^3P)$	1.00×10^{-7}	[?]
R137	$N_4^+ + O_2^- \rightarrow 2N_2 + O_2$	1.00×10^{-7}	[?]
R138	$N_4^+ + O_3^- \rightarrow 2N_2 + O_3$	1.00×10^{-7}	[?]
R139	$N_4^+ + O_4^- \rightarrow 2N_2 + 2O_2$	1.00×10^{-7}	[?]
R140	$O_2^+ + O^- + M \rightarrow O_3 + M$	$2.00 \times 10^{-25}(\frac{300}{T})^{2.5}$	[?]
R141	$O_2^+ + O^- + M \rightarrow O_2 + O(^3P) + M$	$2.00 \times 10^{-25}(\frac{300}{T})^{2.5}$	[?]
R142	$O_2^+ + O^- \rightarrow O_2 + O(^3P)$	$2.00 \times 10^{-7}(\frac{300}{T})^{0.5}$	[?]
R143	$O_2^+ + O^- \rightarrow 3O(^3P)$	1.00×10^{-7}	[?]
R144	$O_2^+ + O_2^- + M \rightarrow 2O_2 + M$	$2.00 \times 10^{-25}(\frac{300}{T})^{2.5}$	[?]
R145	$O_2^+ + O_2^- + O_2 \rightarrow 2O_2 + 2O(^3P)$	$2.00 \times 10^{-25}(\frac{300}{T})^{2.5}$	[?]
R146	$O_2^+ + O_2^- \rightarrow 2O_2$	$2.00 \times 10^{-7}(\frac{300}{T})^{0.5}$	[?]
R147	$O_2^+ + O_2^- \rightarrow O_2 + 2O(^3P)$	1.00×10^{-7}	[?]
R148	$O_2^+ + O_3^- \rightarrow O_2 + O_3$	$2.00 \times 10^{-7}(\frac{300}{T})^{0.5}$	[?]
R149	$O_2^+ + O_3^- \rightarrow 2O_2 + O(^3P)$	7.80×10^{-6}	[?]
R150	$O_2^+ + O_3^- \rightarrow O_3 + 2O(^3P)$	1.00×10^{-7}	[?]
R151	$O_2^+ + O_4^- \rightarrow 3O_2$	1.00×10^{-7}	[?]
R152	$O_4^+ + O^- \rightarrow O_2 + O_3$	7.80×10^{-6}	[?]
R153	$O_4^+ + O^- \rightarrow 2O_2 + O(^3P)$	1.00×10^{-7}	[?]
R154	$O_4^+ + O_2^- + O_2 \rightarrow 3O_2 + 2O(^3P)$	$2.00 \times 10^{-25}(\frac{300}{T})^{2.5}$	[?]
R155	$O_4^+ + O_2^- \rightarrow 3O_2$	1.00×10^{-7}	[?]
R156	$O_4^+ + O_2^- \rightarrow 2O_2 + 2O(^3P)$	2.00×10^{-6}	[?]
R157	$O_4^+ + O_3^- \rightarrow 2O_2 + O_3$	1.00×10^{-7}	[?]
R158	$O_4^+ + O_4^- \rightarrow 4O_2$	1.00×10^{-7}	[?]
R159	$N_2O_2^+ + O^- \rightarrow N_2 + O_2 + O(^3P)$	1.00×10^{-7}	[?]
R160	$N_2O_2^+ + O^- \rightarrow 2NO + O(^3P)$	1.00×10^{-7}	[?]
R161	$N_2O_2^+ + O_2^- \rightarrow N_2 + 2O_2$	1.00×10^{-7}	[?]
R162	$N_2O_2^+ + O_2^- \rightarrow 2NO + O_2$	1.00×10^{-7}	[?]
R163	$N_2O_2^+ + O_3^- \rightarrow N_2 + O_2 + O_3$	1.00×10^{-7}	[?]
R164	$N_2O_2^+ + O_3^- \rightarrow 2NO + O_3$	1.00×10^{-7}	[?]
R165	$N_2O_2^+ + O_4^- \rightarrow N_2 + 3O_2$	1.00×10^{-7}	[?]

Table 3: Considered reactions for neutral species. T (K) is gas temperature.

	Reactions	Rate constants (cm^3s^{-1} or cm^6s^{-1})	Refs.
R166	$N_2(A_1) + O_2 \rightarrow N_2 + O_2(a)$	1.29×10^{-12}	[?]
R167	$N_2(A_1) + O_2 \rightarrow N_2 + O_2(b)$	7.50×10^{-13}	[?]
R168	$N_2(A_1) + O_2 \rightarrow N_2 + 2O(^3P)$	1.70×10^{-12}	[?]
R169	$N_2(A_1) + O_2 \rightarrow N_2O + O(^3P)$	7.80×10^{-14}	[?]
R170	$N_2(A_1) + N_2 \rightarrow 2N_2$	3.00×10^{-16}	[?]
R171	$N_2(A_1) + N_2(A_1) \rightarrow N_2 + N_2(B)$	7.70×10^{-11}	[?]
R172	$N_2(A_1) + N_2(A_1) \rightarrow N_2 + N_2(C)$	1.60×10^{-10}	[?]
R173	$N_2(A_1) + N_2(A_1) \rightarrow N_2 + N_2(E)$	1.00×10^{-11}	[?]
R174	$N_2(A_1) + NO \rightarrow N_2 + NO(A)$	6.90×10^{-11}	[?]
R175	$N_2(A_1) + NO_2 \rightarrow N_2 + NO + O(^3P)$	1.30×10^{-11}	[?]
R176	$N_2(A_1) + N_2O \rightarrow N_2 + NO + N(^4S)$	1.00×10^{-11}	[?]
R177	$N_2(A_1) + N_2O \rightarrow 2N_2 + O(^3P)$	8.00×10^{-11}	[?]
R178	$N_2(A_1) + O(^3P) \rightarrow N_2 + O(^3P)$	2.00×10^{-11}	[?]
R179	$N_2(A_1) + O(^3P) \rightarrow N_2 + O(^1S)$	3.00×10^{-11}	[?]
R180	$N_2(A_1) + O(^3P) \rightarrow NO + N(^2D)$	7.00×10^{-12}	[?]
R181	$N_2(A_1) + N(^4S) \rightarrow N_2 + N(^4S)$	2.00×10^{-12}	[?]
R182	$N_2(A_1) + N(^4S) \rightarrow N_2 + N(^2P)$	5.00×10^{-11}	[?]
R183	$N_2(A_2) + N_2 \rightarrow 2N_2$	3.00×10^{-16}	[?]
R184	$N_2(A_2) + N_2 \rightarrow N_2 + N_2(A_1)$	1.00×10^{-11}	[?]
R185	$N_2(A_2) + NO \rightarrow N_2 + NO(A)$	6.90×10^{-11}	[?]
R186	$N_2(A_2) + NO_2 \rightarrow N_2 + NO + O(^3P)$	1.30×10^{-11}	[?]
R187	$N_2(A_2) + O(^3P) \rightarrow N_2 + O(^3P)$	2.00×10^{-11}	[?]
R188	$N_2(A_2) + O(^3P) \rightarrow NO + N(^4S)$	7.00×10^{-12}	[?]
R189	$N_2(B) + O_2 \rightarrow N_2 + 2O(^3P)$	3.00×10^{-10}	[?]
R190	$N_2(B) + N_2 \rightarrow 2N_2$	2.00×10^{-12}	[?]
R191	$N_2(B) + N_2 \rightarrow N_2 + N_2(A_2)$	2.00×10^{-11}	[?]
R192	$N_2(B) + NO \rightarrow NO + N_2(A_1)$	2.40×10^{-10}	[?]
R193	$N_2(B) \rightarrow N_2(A_1) + h\nu$	1.10×10^{5}	[?]
R194	$N_2(a) + O_2 \rightarrow N_2 + O(^3P) + O(^1D)$	2.80×10^{-11}	[?]
R195	$N_2(a) + N_2 \rightarrow N_2 + N_2(B)$	2.40×10^{-13}	[?]
R196	$N_2(a) + NO \rightarrow N_2 + N(^4S) + O(^3P)$	3.60×10^{-10}	[?]
R197	$N_2(C) + O_2 \rightarrow N_2 + 2O(^3P)$	2.50×10^{-10}	[?]
R198	$N_2(C) + O_2 \rightarrow N_2 + O(^3P) + O(^1S)$	3.00×10^{-10}	[?]
R199	$N_2(C) + N_2 \rightarrow N_2 + N_2(B)$	1.00×10^{-11}	[?]
R200	$N_2(C) + N_2 \rightarrow N_2 + N_2(a)$	1.00×10^{-11}	[?]
R201	$N_2(C) \rightarrow N_2(B) + h\nu$	2.40×10^{7}	[?]
R202	$N_2(E) + N_2 \rightarrow N_2 + N_2(C)$	1.00×10^{-11}	[?]

Table 3: (continued)

	Reactions	Rate constants (cm^3s^{-1} or cm^6s^{-1})	Refs.
R203	$N(^4S) + O_2 \rightarrow NO + O(^3P)$	$9.70 \times 10^{-15} T^{1.01} \exp(\frac{-3120}{T})$	[?]
R204	$N(^4S) + O_3 \rightarrow NO + O_2$	2.00×10^{-16}	[?]
R205	$N(^4S) + NO \rightarrow N_2 + O(^3P)$	$3.51 \times 10^{-11} \exp(\frac{-49.84}{T})$	[?]
R206	$N(^4S) + NO_2 \rightarrow N_2 + O_2$	7.00×10^{-13}	[?]
R207	$N(^4S) + NO_2 \rightarrow N_2 + 2O(^3P)$	9.10×10^{-13}	[?]
R208	$N(^4S) + NO_2 \rightarrow 2NO$	2.30×10^{-12}	[?]
R209	$N(^4S) + NO_2 \rightarrow N_2O + O(^3P)$	3.00×10^{-12}	[?]
R210	$N(^4S) + O(^3P) + M \rightarrow NO + M$	$1.76 \times 10^{-31} T^{-0.5}$	[?]
R211	$N(^4S) + O(^3P) + O(^3P) \rightarrow O_2 + N(^4S)$	$3.20 \times 10^{-33} (\frac{300}{T})^{0.41}$	[?]
R212	$N(^4S) + O(^1S) \rightarrow O(^3P) + N(^4S)$	1.00×10^{-12}	[?]
R213	$N(^4S) + N(^4S) + N_2 \rightarrow N_2 + N_2(A_1)$	$1.38 \times 10^{-34} \exp(\frac{-500}{T})$	[?]
R214	$N(^4S) + N(^4S) + N_2 \rightarrow N_2 + N_2(A_2)$	$1.38 \times 10^{-34} \exp(\frac{-500}{T})$	[?]
R215	$N(^4S) + N(^4S) + N_2 \rightarrow N_2 + N_2(B)$	2.40×10^{-33}	[?]
R216	$N(^4S) + N(^4S) + M \rightarrow N_2 + M$	$8.27 \times 10^{-34} \exp(\frac{500}{T})$	[?]
R217	$N(^4S) + N(^4S) + N(^4S) \rightarrow N_2 + N(^4S)$	$3.31 \times 10^{-27} (\frac{300}{T})^{1.5}$	[?]
R218	$N(^4S) + N(^2P) \rightarrow N(^4S) + N(^2D)$	1.80×10^{-12}	[?]
R219	$N(^2D) + O_2 \rightarrow NO + O(^3P)$	$2.52 \times 10^{-12} \exp(\frac{-185}{T})$	[?]
R220	$N(^2D) + O_2 \rightarrow NO + O(^1D)$	$7.37 \times 10^{-12} \exp(\frac{-185}{T})$	[?]
R221	$N(^2D) + N_2 \rightarrow N_2 + N(^4S)$	1.70×10^{-14}	[?]
R222	$N(^2D) + NO \rightarrow N_2 + O(^3P)$	1.80×10^{-10}	[?]
R223	$N(^2D) + NO \rightarrow N_2O$	6.00×10^{-11}	[?]
R224	$N(^2D) + N_2O \rightarrow NO + N_2$	3.00×10^{-12}	[?]
R225	$N(^2D) + O(^3P) \rightarrow N(^4S) + O(^3P)$	$3.30 \times 10^{-12} \exp(\frac{-260}{T})$	[?]
R226	$N(^2D) + O(^3P) \rightarrow N(^4S) + O(^1D)$	4.00×10^{-13}	[?]
R227	$N(^2P) + O_2 \rightarrow NO + O(^3P)$	2.60×10^{-12}	[?]
R228	$N(^2P) + N_2 \rightarrow N_2 + N(^2D)$	2.00×10^{-18}	[?]
R229	$N(^2P) + NO \rightarrow N_2(A_1) + O(^3P)$	3.40×10^{-11}	[?]
R230	$N(^2P) + O(^3P) \rightarrow N(^4S) + O(^3P)$	1.00×10^{-12}	[?]
R231	$O_2(a) + O_2 \rightarrow 2O_2$	$2.20 \times 10^{-18} (\frac{T}{300})^{0.8}$	[?]
R232	$O_2(a) + O_2(a) + O_2 \rightarrow 2O_3$	1.00×10^{-31}	[?]
R233	$O_2(a) + O_2(a) \rightarrow O_2 + O_2(b)$	$7.00 \times 10^{-28} T^{3.8} \exp(\frac{700}{T})$	[?]
R234	$O_2(a) + O_3 \rightarrow 2O_2 + O(^3P)$	$9.70 \times 10^{-13} \exp(\frac{-1564}{T})$	[?]
R235	$O_2(a) + N_2 \rightarrow O_2 + N_2$	3.00×10^{-21}	[?]
R236	$O_2(a) + NO \rightarrow NO + O_2$	2.50×10^{-11}	[?]
R237	$O_2(a) + NO \rightarrow NO_2 + O(^3P)$	4.88×10^{-18}	[?]
R238	$O_2(a) + O(^3P) \rightarrow O_2 + O(^3P)$	7.00×10^{-16}	[?]
R239	$O_2(a) + O(^1S) \rightarrow 3O(^3P)$	3.40×10^{-11}	[?]
R240	$O_2(a) + O(^1S) \rightarrow O_2(b) + O(^1D)$	3.60×10^{-11}	[?]
R241	$O_2(a) + O(^1S) \rightarrow O_2(A) + O(^3P)$	1.30×10^{-10}	[?]
R242	$O_2(a) + N(^4S) \rightarrow NO + O(^3P)$	$2.00 \times 10^{-14} \exp(\frac{-600}{T})$	[?]
R243	$O_2(b) + O_2 \rightarrow O_2 + O_2(a)$	$4.30 \times 10^{-22} T^{2.4} \exp(\frac{-241}{T})$	[?]
R244	$O_2(b) + O_3 \rightarrow 2O_2 + O(^3P)$	1.80×10^{-11}	[?]
R245	$O_2(b) + N_2 \rightarrow N_2 + O_2(a)$	$4.90 \times 10^{-15} \exp(\frac{-253}{T})$	[?]
R246	$O_2(b) + NO \rightarrow NO + O_2(a)$	4.00×10^{-14}	[?]
R247	$O_2(b) + O(^3P) \rightarrow O_2(a) + O(^3P)$	8.00×10^{-14}	[?]
R248	$O_2(b) + O(^3P) \rightarrow O_2 + O(^1D)$	$3.39 \times 10^{-11} (\frac{300}{T})^{0.1} \exp(\frac{-4201}{T})$	[?]
R249	$O_2(A) + O_2 \rightarrow 2O_2(b)$	2.90×10^{-13}	[?]
R250	$O_2(A) + N_2 \rightarrow N_2 + O_2(b)$	3.00×10^{-13}	[?]
R251	$O_2(A) + O(^3P) \rightarrow O_2(b) + O(^1D)$	9.00×10^{-12}	[?]

Table 3: (continued)

	Reactions	Rate constants (cm^3s^{-1} or cm^6s^{-1})	Refs.
R252	$O(^3P) + O_2 + O_2 \rightarrow O_3 + O_2$	$6.90 \times 10^{-34}(\frac{300}{T})^{1.25}$	[?]
R253	$O(^3P) + O_2 + O_3 \rightarrow 2O_3$	$1.50 \times 10^{-34}\exp(\frac{750}{T})$	[?]
R254	$O(^3P) + O_2 + N_2 \rightarrow O_3 + N_2$	$6.20 \times 10^{-34}(\frac{300}{T})^{2}$	[?]
R255	$O(^3P) + O_3 \rightarrow 2O_2$	$2.00 \times 10^{-11}\exp(\frac{-2300}{T})$	[?]
R256	$O(^3P) + NO + O_2 \rightarrow NO_2 + O_2$	$9.30 \times 10^{-32}(\frac{300}{T})^{1.682}$	[?]
R257	$O(^3P) + NO + N_2 \rightarrow NO_2 + N_2$	$1.20 \times 10^{-31}(\frac{300}{T})^{1.682}$	[?]
R258	$O(^3P) + NO \rightarrow NO_2$	$3.02 \times 10^{-11}(\frac{300}{T})^{0.75}$	[?]
R259	$O(^3P) + NO_2 + M \rightarrow NO_3 + M$	$8.90 \times 10^{-32}(\frac{300}{T})^{2}$	[?]
R260	$O(^3P) + NO_2 \rightarrow NO + O_2$	$1.13 \times 10^{-11}(\frac{T}{1000})^{0.18}$	[?]
R261	$O(^3P) + NO_3 \rightarrow NO_2 + O_2$	1.00×10^{-11}	[?]
R262	$O(^3P) + O(^3P) + O_2 \rightarrow 2O_2$	$2.45 \times 10^{-31}T^{-0.63}$	[?]
R263	$O(^3P) + O(^3P) + O_2 \rightarrow O_3 + O(^3P)$	$2.15 \times 10^{-34}\exp(\frac{345}{T})$	[?]
R264	$O(^3P) + O(^3P) + N_2 \rightarrow O_2 + N_2$	$2.76 \times 10^{-34}\exp(\frac{720}{T})$	[?]
R265	$O(^3P) + O(^1D) + N_2 \rightarrow O_2 + N_2$	9.90×10^{-33}	[?]
R266	$O(^3P) + O(^1D) \rightarrow 2O(^3P)$	8.00×10^{-12}	[?]
R267	$O(^3P) + O(^1S) \rightarrow O(^3P) + O(^1D)$	$5.00 \times 10^{-11}\exp(\frac{-301}{T})$	[?]
R268	$O(^1D) + O_2 \rightarrow O_2 + O(^3P)$	$3.12 \times 10^{-11}\exp(\frac{70}{T})$	[?]
R269	$O(^1D) + O_2 \rightarrow O_2(a) + O(^3P)$	1.00×10^{-12}	[?]
R270	$O(^1D) + O_2 \rightarrow O_2(b) + O(^3P)$	$2.56 \times 10^{-11}\exp(\frac{67}{T})$	[?]
R271	$O(^1D) + O_3 \rightarrow 2O_2$	$2.37 \times 10^{-10}\exp(\frac{6}{T})$	[?]
R272	$O(^1D) + O_3 \rightarrow O_2 + 2O(^3P)$	$2.37 \times 10^{-10}\exp(\frac{6}{T})$	[?]
R273	$O(^1D) + O_3 \rightarrow O_3 + O(^3P)$	2.41×10^{-10}	[?]
R274	$O(^1D) + N_2 + N_2 \rightarrow N_2O + N_2$	2.80×10^{-36}	[?]
R275	$O(^1D) + N_2 \rightarrow N_2 + O(^3P)$	$2.10 \times 10^{-11}\exp(\frac{115}{T})$	[?]
R276	$O(^1D) + NO \rightarrow O_2 + N(^4S)$	1.70×10^{-10}	[?]
R277	$O(^1D) + NO_2 \rightarrow NO + O_2$	3.00×10^{-10}	[?]
R278	$O(^1D) + N_2O \rightarrow N_2 + O_2$	$1.11 \times 10^{-10}\exp(\frac{17}{T})$	[?]
R279	$O(^1D) + N_2O \rightarrow 2NO$	$1.11 \times 10^{-10}\exp(\frac{17}{T})$	[?]
R280	$O(^1D) + N_2O \rightarrow N_2O + O(^3P)$	1.00×10^{-12}	[?]
R281	$O(^1S) + O_2 \rightarrow O_2 + O(^1D)$	$1.33 \times 10^{-12}\exp(\frac{-850}{T})$	[?]
R282	$O(^1S) + O_2 \rightarrow O_2(A) + O(^3P)$	$2.97 \times 10^{-12}\exp(\frac{-850}{T})$	[?]
R283	$O(^1S) + O_3 \rightarrow 2O_2$	2.90×10^{-10}	[?]
R284	$O(^1S) + O_3 \rightarrow O_2 + O(^3P) + O(^1D)$	2.90×10^{-10}	[?]
R285	$O(^1S) + NO \rightarrow NO + O(^3P)$	1.80×10^{-10}	[?]
R286	$O(^1S) + NO \rightarrow NO + O(^1D)$	3.20×10^{-10}	[?]
R287	$O(^1S) + N_2O \rightarrow N_2O + O(^3P)$	6.30×10^{-12}	[?]
R288	$O(^1S) + N_2O \rightarrow N_2O + O(^1D)$	3.10×10^{-12}	[?]
R289	$NO(A) + O_2 \rightarrow NO + O_2$	1.51×10^{-10}	[?]
R290	$NO(A) + N_2 \rightarrow NO + N_2(A_1)$	5.00×10^{-14}	[?]
R291	$NO(A) \rightarrow NO + h\nu$	5.10×10^{6}	[?]
R292	$NO + O_3 \rightarrow NO_2 + O_2$	$4.30 \times 10^{-12}\exp(\frac{-1560}{T})$	[?]
R293	$NO + NO + O_2 \rightarrow 2NO_2$	$3.30 \times 10^{-39}\exp(\frac{530}{T})$	[?]
R294	$NO + NO_2 + N_2 \rightarrow N_2O_3 + N_2$	$3.10 \times 10^{-34}(\frac{300}{T})^{7.7}$	[?]
R295	$NO + NO_2 + NO_3 \rightarrow NO + N_2O_5$	$5.90 \times 10^{-29}(\frac{300}{T})^{1.27}$	[?]
R296	$NO + NO_3 \rightarrow 2NO + O_2$	$2.71 \times 10^{-11}T^{-0.23}\exp(\frac{-947}{T})$	[?]
R297	$NO + NO_3 \rightarrow 2NO_2$	$1.80 \times 10^{-11}\exp(\frac{110}{T})$	[?]
R298	$NO_2 + O_3 \rightarrow NO_3 + O_2$	$1.20 \times 10^{-13}\exp(\frac{-2450}{T})$	[?]
R299	$NO_2 + NO_2 + N_2 \rightarrow N_2O_4 + N_2$	$1.40 \times 10^{-33}(\frac{300}{T})^{3.8}$	[?]
R300	$NO_2 + NO_3 + M \rightarrow N_2O_5 + M$	$5.90 \times 10^{-29}(\frac{300}{T})^{1.27}$	[?]
R301	$NO_2 + NO_3 \rightarrow NO + NO_2 + O_2$	$2.30 \times 10^{-13}\exp(\frac{-1600}{T})$	[?]
R302	$NO_2 + NO_3 \rightarrow N_2O_5$	1.10×10^{-12}	[?]
R303	$NO_3 + NO_3 \rightarrow 2NO_2 + O_2$	$5.00 \times 10^{-12}\exp(\frac{-3000}{T})$	[?]
R304	$O_3 + O_3 \rightarrow O_2 + O_3 + O(^3P)$	$7.16 \times 10^{-10}\exp(\frac{-11200}{T})$	[?]

Table 4: Effective electronic states of N_2 and O_2 considered in the simulation.

Electronic states	Excitation energy (eV)	Effective states
$N_2(X,\, v = 0)$	0	N_2(X)
$N_2(A^3\Sigma_u^+,\, v = 0...4)$	6.17	$N_2(A_1)$
$N_2(A^3\Sigma_u^+,\, v = 5...9)$	7.00	$N_2(A_2)$
$N_2(B^3\Pi_g)$	7.35	N_2(B)
$N_2(W^3\Delta_u)$	7.36	N_2(B)
$N_2(A^3\Sigma_u^+,\, v > 10)$	7.80	N_2(B)
$N_2(B'^3\Sigma_u^-)$	8.16	N_2(B)
$N_2(a'^1\Sigma_u^-)$	8.40	N_2(a)
$N_2(a^1\Pi_g)$	8.55	N_2(a)
$N_2(w^1\Delta_u)$	8.89	N_2(a)
$N_2(C^3\Pi_u)$	11.03	N_2(C)
$N_2(E^3\Sigma_g^+)$	11.87	N_2(E)
$N_2(a''^1\Sigma_g^+)$	12.25	N_2(E)
$O_2(a^1\Delta_g)$	0.977	O_2(a)
$O_2(b^1\Sigma_g^+)$	1.627	O_2(b)
$O_2(c^1\Sigma_u^-)$	4.05	O_2(A)
$O_2(A'^3\Delta_u)$	4.26	O_2(A)
$O_2(A^3\Sigma_u^+)$	4.34	O_2(A)