Table 1: List of reactions

	Rectants	→	Products	Rate constant	Units	References	#	Comments
	Generation of electrons by direct ionization: F_{ion}							
R1	M + e	→	O_2^+ + e + e	ν_i	(1/s)	[*Morrow and Lowke*, 1997]		$\nu_i = k_{iz,O_2}[O_2] + k_{iz,N_2}[N_2]$; M=$N_2$, O_2
R2	NO + e	→	NO^+ + e + e	$5.0{\times}10^{-9}\exp(-460/(E/n))F$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(3)	
R3	O + e	→	O^+ + e + e	$4.0{\times}10^{-9}\exp(-713/(E/n))F$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(4)	
	Generation of electrons by stepwise ionizations: F_{step}							
R4	N_2(A) + N_2(a′)	→	N_4^+ + e	$5{\times}10^{-11}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(25)	$N_4^+ + O_2 \to O_2^+ + N_2 + N_2$
R5	N_2(a′) + N_2(a′)	→	N_4^+ + e	$2{\times}10^{-10}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(26)	$N_4^+ + O_2 \to O_2^+ + N_2 + N_2$
	Loss of electrons by two and three body attachment processes: $F_{a_2} + F_{a_3}$							
R6	O_2 + e	→	O^- + O	ν_{a_2}	(1/s)	[*Morrow and Lowke*, 1997]		$\nu_{a_2} = k_{a_2}[O_2]$
R7	O_2 + e + M	→	O_2^- + M	ν_{a_3}	(1/s)	[*Morrow and Lowke*, 1997]		$\nu_{a_3} = k_{a_3}[O_2][M]$; M=$N_2$, O_2
R8	O_2 + O + e	→	O + O_2^-	10^{-31}	(cm^6/s)	[*Kossyi et al.*, 1992]	(48)	
	Loss of electrons by electron-ion recombination: F_{rec}							
R9	O_2^+ + e	→	O + O	$2{\times}10^{-7}{\times}(300/T_e)$	(cm^3/s)	[*Kossyi et al.*, 1992]	(40)	
R10	O_2^+ + e + M	→	O_2 + M	$6{\times}10^{-27}{\times}(300/T_e)^{1.5}$	(cm^6/s)	[*Kossyi et al.*, 1992]	(44)	A=O_2^+; M=O_2, N_2
R11	O_4^+ + e	→	O_2 + O_2	$1.4{\times}10^{-6}{\times}(300/T_e)^{1/2}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(30)	
R12	$O_2^+N_2$ + e	→	O_2 + N_2	$1.3{\times}10^{-6}{\times}(300/T_e)^{1/2}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(34)	
	Generation of electrons by detachment: F_d							
R13	O_2^- + O_2(a)	→	O_2 + O_2 + e	$2{\times}10^{-10}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(58)	
R14	O_2^- + N_2(A)	→	O_2 + N_2 + e	$2.1{\times}10^{-9}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(60)	
R15	O^- + N_2	→	N_2O + e	$9{\times}10^{-13}$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(22)	
R16	O^- + O	→	O_2 + e	$5{\times}10^{-10}$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(23)	
R17	O_2^- + O	→	O_3 + e	$1.5{\times}10^{-10}$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(25)	
R18	O_3^- + O	→	O_2 + O_2 + e	$3{\times}10^{-10}$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(26)	
R19	O^- + O_2(a)	→	O_3 + e	$3{\times}10^{-10}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(62)	
R20	O^- + N_2(A)	→	O + N_2 + e	$2.2{\times}10^{-9}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(64)	
R21	O^- + NO	→	NO_2 + e	$2.6{\times}10^{-10}$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(24)	
R22	O_2^- + O_2	→	O_2 + O_2 + e	$2{\times}10^{-10}e^{-0.52/T_{ef2}}\frac{1-e^{-4\theta}}{1-e^{-\theta}}$ $\theta=0.13{\times}(1/T_g(\mathrm{eV}) - 1/T_{ef2})$ $T_{ef2}=T_g(\mathrm{eV}) + 5.2{\times}10^{-6}{\times}(E/n)^2$ (eV)	(cm^3/s)	[*Benilov and Naidis*, 2003]	(21)	
	Electron impact excitation of metastable state							
R23	O_2 + e	→	O_2(a) + e + e	$\nu_{O_2(a)}$	(1/s)	[*Aleksandrov et al.*, 1995]		$\nu_{O_2(a)} = k_{O_2(a)}[O_2]$
R24	N_2 + e	→	N_2(A) + e + e	$\nu_{N_2(A)}$	(1/s)	[*Aleksandrov et al.*, 1995]		$\nu_{m,N_2} = k_{N_2(A)}[N_2]$
R25	N_2 + e	→	N_2(a′) + e + e	$\nu_{N_2(a')}$	(1/s)	[*Aleksandrov et al.*, 1995]		$\nu_{N_2,a} = k_{N_2(a')}[N_2]$
R26	N_2 + e	→	N_2(B) + e + e	ν_{1P}	(1/s)	[*Aleksandrov et al.*, 1995]		$\nu_{1P} = k_{1P}[N_2]$
R27	N_2 + e	→	N_2(C) + e + e	ν_{2P}	(1/s)	[*Aleksandrov et al.*, 1995]		$\nu_{2P} = k_{2P}[N_2]$
	Electron impact dissociation							
R28	N_2 + e	→	N + N + e	$5.0{\times}10^{-9}\exp(-646/(E/n))F$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(5)	
R29	O_2 + e	→	O + O + e	$5.0{\times}10^{-9}\exp(-324/(E/n))F$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(6)	
	Ground states chemistry							
R30	N + NO	→	O + N_2	$1.1{\times}10^{-10}{\times}T_g(\mathrm{eV})^{1/2}$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(15)	
R31	N + O_2	→	O + NO	$1.2{\times}10^{-10}{\times}T_g(\mathrm{eV})^{1/2}$	(cm^3/s)	[*Benilov and Naidis*, 2003]	(17)	
	Active states chemistry and collisional and radiative deactivation							
R32	N_2(B)	→	N_2(A) + $h\nu$(1PN_2)	$1.7{\times}10^{5}$	(1/s)	[*Liu and Pasko*, 2004]		[*Walter et al.*, 1994]
R33	N_2(C)	→	N_2(B) + $h\nu$(2PN_2)	$2.0{\times}10^{7}$	(1/s)	[*Liu and Pasko*, 2004]		[*Walter et al.*, 1994]
R34	N_2(B) + N_2	→	N_2 + N_2	$1.0{\times}10^{-11}$	(cm^3/s)	[*Vallance-Jones*, 1974]		Table 4.7

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Table 1 – Continued

	Rectants	→	Products	Rate constant	Units	References	#	Comments
R35	$N_2(C)$ + O_2	→	N_2 + O_2	3.0×10^{-10}	(cm^3/s)	[*Vallance-Jones*, 1974]		Table 4.7
R36	$O_2(a)$ + O_2	→	O_2 + O_2	$2.2\times10^{-18}\times(T_g/300)^{0.8}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(123)	[*Lowke*, 1992, (6)]
R37	$N_2(A)$ + O	→	NO + $N(^1D)$	7×10^{-12}	(cm^3/s)	[*Kossyi et al.*, 1992]	(102)	
R38	$N_2(A)$ + $N_2(A)$	→	$N_2(C)$ + N_2	$(1.6+0.77)\times10^{-10}$	(cm^3/s)	[*Popov*, 2001]	(3–4)	[*Kossyi et al.*, 1992, (104)]
R39	$N_2(A)$ + O	→	N_2 + $O(^1S)$	2.1×10^{-11}	(cm^3/s)	[*Kossyi et al.*, 1992]	(108)	
R40	$N_2(A)$ + O_2	→	N_2 + O + O	2.54×10^{-12}	(cm^3/s)	[*Kossyi et al.*, 1992]	(100)	
R41	$N_2(a')$ + O_2	→	N_2 + O + O	2.8×10^{-11}	(cm^3/s)	[*Kossyi et al.*, 1992]	(115)	
			Ion-ion recombination					
	A^- + B^+	→	A + B	$2\times10^{-7}\times(300/T_g)^{0.5}$	(cm^3/s)	[*Kossyi et al.*, 1992]	(I)	
R42	O^- + O_2^+	→	O + O_2					$A^-=O^-$; $B^+=O_2^+$
R43	O_2^- + O_2^+	→	O_2 + O_2					$A^-=O_2^-$; $B^+=O_2^+$
R44	O_3^- + O_2^+	→	O_3 + O_2					$A^-=O_3^-$; $B^+=O_2^+$
	A^- + BC^+	→	A + B + C	10^{-7}	(cm^3/s)	[*Kossyi et al.*, 1992]	(II)	
R45	O^- + O_2^+	→	O + O + O					$A^-=O^-$; $BC^+=O_2^+$
R46	O^- + O_4^+	→	O + O_2 + O_2					$A^-=O^-$; $BC^+=O_4^+$
R47	O^- + $O_2^+N_2$	→	O + O_2 + N_2					$A^-=O^-$; $BC^+=O_2^+N_2$
R48	O_2^- + O_2^+	→	O_2 + O + O					$A^-=O_2^-$; $BC^+=O_2^+$
R49	O_2^- + O_4^+	→	O_2 + O_2 + O_2					$A^-=O_2^-$; $BC^+=O_4^+$
R50	O_2^- + $O_2^+N_2$	→	O_2 + O_2 + N_2					$A^-=O_2^-$; $BC^+=O_2^+N_2$
R51	O_3^- + O_2^+	→	O_3 + O + O					$A^-=O_3^-$; $BC^+=O_2^+$
R52	O_3^- + O_4^+	→	O_3 + O_2 + O_2					$A^-=O_3^-$; $BC^+=O_4^+$
R53	O_3^- + $O_2^+N_2$	→	O_3 + O_2 + N_2					$A^-=O_3^-$; $BC^+=O_2^+N_2$
	A^- + B^+ + M	→	A + B + M	$2\times10^{-25}\times(300/T_g)^{2.5}$	(cm^6/s)	[*Kossyi et al.*, 1992]	(V)	
R54	O^- + O_2^+ + M	→	O + O_2 + M					$A^-=O^-$; $B^+=O_2^+$; $M=N_2, O_2$
R55	O_2^- + O_2^+ + M	→	O_2 + O_2 + M					$A^-=O_2^-$; $B^+=O_2^+$; $M=N_2, O_2$
	A^- + B^+ + M	→	AB + M	$2\times10^{-25}\times(300/T_g)^{2.5}$	(cm^6/s)	[*Kossyi et al.*, 1992]	(VI)	
R56	O^- + O_2^+ + M	→	O_3 + M					$A^-=O^-$; $B^+=O_2^+$; $M=N_2, O_2$
			Positive ions chemistry					
R57	O_4^+ + $O_2(a)$	→	O_2^+ + O_2 + O_2	10^{-10}	(cm^3/s)	[*Kossyi et al.*, 1992]	(228)	
R58	O_4^+ + O	→	O_2^+ + O_3	3×10^{-10}	(cm^3/s)	[*Kossyi et al.*, 1992]	(229)	
R59	O_3^- + O	→	O_2^- + O_2	3.2×10^{-10}	(cm^3/s)	[*Kossyi et al.*, 1992]	(247)	
R60	O_2^+ + O_2 + O_2	→	O_4^+ + O_2	$2.4\times10^{-30}\times(300/T_g)^{3.2}$	(cm^6/s)	[*Kossyi et al.*, 1992]	(167)	
R61	$O_2^+N_2$ + O_2	→	O_4^+ + N_2	10^{-9}	(cm^3/s)	[*Kossyi et al.*, 1992]	(232)	
R62	O_2^+ + N_2 + N_2	→	$O_2^+N_2$ + N_2	$0.9\times10^{-30}\times(300/T_g)^2$	(cm^6/s)	[*Kossyi et al.*, 1992]	(168)	
R63	O_4^+ + N_2	→	$O_2^+N_2$ + O_2	$4.61\times10^{-12}\times(300/T_g)^{2.5}\times\exp(-2650/T_g)$	(cm^6/s)	[*Kossyi et al.*, 1992]	(226)	
R64	$O_2^+N_2$ + N_2	→	O_2^+ + N_2 + N_2	$1.1\times10^{-6}\times(300/T_g)^{5.3}\times\exp(-2357/T_g)$	(cm^6/s)	[*Kossyi et al.*, 1992]	(231)	
R68	O_4^+ + O_2	→	O_2^+ + O_2 + O_2	$3.3\times10^{-6}\times(300/T_g)^4\times\exp(-5030/T_g)$	(cm^6/s)	[*Kossyi et al.*, 1992]	(227)	
			Negative ions chemistry					
R65	O^- + $O_2(a)$	→	O_2^- + O	10^{-10}	(cm^3/s)	[*Kossyi et al.*, 1992]	(242)	
R66	O_2^- + O	→	O_2 + O^-	3.3×10^{-10}	(cm^3/s)	[*Kossyi et al.*, 1992]	(237)	
R67	O_3^- + O	→	O_2^- + O_2	3.2×10^{-10}	(cm^3/s)	[*Kossyi et al.*, 1992]	(247)	
R68	O^- + O_2 + M	→	O_3^- + M	$2.8\times10^{-32}\times T_{ef1}^{-1}$ $T_{ef1}=T_g(eV)+6.9\times10^{-6}\times(E/n)^2$ (eV)	(cm^6/s)	[*Benilov and Naidis*, 2003]	(27)	$M=N_2, O_2$