Supplemental Material to the article

"Features of transition processes in DC micro discharges in molecular gases: from glow to the arc discharge with a non-free or free cathode mode"

The set of elementary processes used in the work is shown in Table 1, and the main gas heating channels in Table 2.

Table 1. Set of plasma-chemical reactions in a discharge in nitrogen

#	Reaction	Reaction rate constant, m^3/s, or m^6/s, $1/s$	Reference
1	$N_2 + e \to N_2 + e$	$f(\sigma, E/N)$	[17]
2	$N_2 + e \to N_2(rot) + e$	$f(\sigma, E/N)$	[17]
3	$N_2 + e \to N_2(v) + e$	$f(\sigma, E/N)$	[17]
4	$N_2 + e \to N_2(A3) + e$	$f(\sigma, E/N)$	[17]
5	$N_2 + e \to N_2(B3) + e$	$f(\sigma, E/N)$	[17]
6	$N_2 + e \to N_2(C3) + e$	$f(\sigma, E/N)$	[17]
7	$N_2 + e \to N_2(al) + e$	$f(\sigma, E/N)$	[17]
8	$N_2 + e \to N_2^+ + e + e$	$f(\sigma, E/N)$	[17]
9	$N_2(A3) + e \leftrightarrow N_2^+ + e + e$	$f(\sigma, E/N)$	[17]
10	$N_2(al) + e \leftrightarrow N_2^+ + e + e$	$f(\sigma, E/N)$	[17]
11	$N_2 + e \to N + N + e$	$f(\sigma, E/N)$	[17]
12	$N + e \to N^+ + e + e$	$f(\sigma, E/N)$	[17]
13	$N + e \to N(D) + e$	$f(\sigma, E/N)$	[17]
14	$N + e \to N(P) + e$	$f(\sigma, E/N)$	[17]
15	$N(D) + e \to N(P) + e$	$f(\sigma, E/N)$	[17]
16	$N(D) + e \to N^+ + e + e$	$f(\sigma, E/N)$	[17]
17	$N(P) + e \to N^+ + e + e$	$f(\sigma, E/N)$	[17]
18	$N_2(A3) + N_2(al) \to N_4^+ + e$	$5.0 \cdot 10^{-17}$	[14]
19	$N_2(al) + N_2(al) \to N_4^+ + e$	$2.0 \cdot 10^{-16}$	[14]
20	$N(D) + N(P) \to N_4^+ + e$	$3.2 \cdot 10^{-21} T^{0.98}/[1 - \exp(-3129/T)]$	[14]
21	$N(P) + N(P) \to N_2^+ + e$	$1.92 \cdot 10^{-21} T^{0.98}/[1 - \exp(-3129/T)]$	[14]
22	$N_4^+ + N_2 \to N_2^+ + N_2 + N_2$	$8.1 \cdot 10^{-17} \exp(-4842/(T + T_v))$	[14]
23	$N_2^+ + N_2 + N_2 \to N_4^+ + N_2$	$5.2 \cdot 10^{-41} (300/T)^{2.2}$	[14]
24	$N^+ + N_2 + N_2 \to N_3^+ + N_2$	$1.72 \cdot 10^{-41} (300/T)^{2.1}$	[14]
25	$N^+ + N + N_2 \to N_2^+ + N_2$	$1.0 \cdot 10^{-29}$	[17]
26	$N_2^+ + N \to N^+ + N_2$	$7.2 \cdot 10^{-13} (300/T)$	[14]
27	$N_3^+ + N \to N_2^+ + N_2$	$6.6 \cdot 10^{-17}$	[14]
28	$N_4^+ + N \to N^+ + N_2 + N_2$	$1.0 \cdot 10^{-17}$	[14]
29	$N_4^+ + N \to N_3^+ + N$	$1.0 \cdot 10^{-15}$	[14]
30	$N_2^+ + N_2(A3) \to N_3^+ + N_2$	$3.0 \cdot 10^{-16}$	[14]
31	$N_2^+ + N_2(A3) \to N^+ + N + N_2$	$4.0 \cdot 10^{-16}$	[16]
32	$N_3^+ + N_2(A3) \to N^+ + N_2 + N_2$	$6.0 \cdot 10^{-16}$	[14]
33	$N_2^+ + N_2 \to N^+ + N + N_2$	$1.2 \cdot 10^{-17}$	[16]
34	$N_3^+ + N_2 \to N^+ + N_2 + N_2$	$6.2 \cdot 10^{-16} \exp(-17000/(T + T_v))$	[16]
35	$N^+ + N_2 \to N_2^+ + N$	$1.0 \cdot 10^{-18}$	[16]
36	$N_3^+ + N \to N_2^+ + N$	$6.6 \cdot 10^{-17}$	[14]
37	$N_2^+ + N \to N_3^+ + N$	$5.5 \cdot 10^{-18}$	[16]
38	$N_2(A3) + N_2(A3) \to N_2(C3) + N_2$	$1.6 \cdot 10^{-16}$	[14]
39	$N_2(A3) + N_2(A3) \to N_2(B3) + N_2$	$3.0 \cdot 10^{-16}$	[14, 17]

14	$N_2(B3) + N_2 \to N_2(A3) + N_2$	$3.0 \cdot 10^{-17}$	[14]
17	$N_2(B3) \to N_2(A3) + h\nu$	$1.5 \cdot 10^{5}$	[14, 17]
16	$N_2(C3) \to N_2(B3) + h\nu$	$3.0 \cdot 10^{7}$	[14, 17]
43	$N_2(al) \to N_2 + h\nu$	$1.0 \cdot 10^{2}$	[17]
44	$N_2(C3) + N_2 \to N_2(B3) + N_2$	$3.3 \cdot 10^{-17}$	[17]
45	$N_2(C3) + N_2 \to N_2(al) + N_2$	$1.0 \cdot 10^{-17}$	[14]
46	$N_2(C3) + N_2 \to N_2(A3) + N_2$	$1.1 \cdot 10^{-17}$	[17]
17	$N_2(al) + N_2 \to N_2(B3) + N_2$	$1.9 \cdot 10^{-19}$	[14]
48	$N_2(al) + N_2 \to N_2(A3) + N_2$	$2.0 \cdot 10^{-19}$	[17]
49	$N_2(d) + N_2 \to N + N_2$	$6.0 \cdot 10^{-21}$	[17]
50	$N_2(p) + N_2 \to N + N_2$	$2.89 \cdot 10^{-18} T^{0.5}$	[17]
51	$N + N + N_2 \to N + N_2$	$8.27 \cdot 10^{-43} \exp(-500/T)$	[17]
52	$N + N + N_2 \to N_2(C3) + N_2$	$1.0 \cdot 10^{-43}$	[17]
53	$N + N(d) + N_2 \to N_2(B3) + N_2$	$1.0 \cdot 10^{-34}$	[17]
54	$N_4^+ + e \to N_2 + N_2$	$2.3 \cdot 10^{-13} (300/T_e)^{0.5}$	[14, 16]
55	$N_2^+ + e \to N + N$	$1.80 \cdot 10^{-13} (300/T_e)^{0.39}$	[14, 16]
57	$N_3^+ + e \to N + N_2$	$2.0 \cdot 10^{-13} (300/T_e)^{0.5}$	[14, 16]
58	$N_2 + N_2(v) \to N_2 + N_2$	$7.8 \cdot 10^{-18} T \exp\left(-\frac{218}{T^{1/3}} + \frac{690}{T}\right) \times$ $\times \left(1 - \exp\left(-\frac{\hbar w_0}{kT}\right)\right)^{-1}$	[14]
59	$N + N_2(v) \to N + N_2$	$2.3 \cdot 10^{-19} T \exp\left(-\frac{1280}{T}\right) +$ $+ 2.7 \cdot 10^{-17} \exp\left(-\frac{10840}{T}\right)$	[14]

Table 2. Main gas heating channels

$R_{Q\,\mathrm{diss}}$	$N_2^+ + e \to N + N$	3.7(eV)	[14, 16]
R_{Qq1}	$N_2(A3) + N_2(A3) \to N_2(C3) + N_2$	1.31(eV)	[14]
R_{Qq2}	$N_2(A3) + N_2(A3) \to N_2(B3) + N_2$	4.18(eV)	[14]
R_{QVT}	$N_2 + N_2(v) \to N_2 + N_2$ $N + N_2(v) \to N + N_2$		
R_{Qrec}	$N_2 + e \to N + N + e + 0.9(\mathrm{eV})$	0.9(eV)	[17]