

Effectiveness of noble gas addition for plasma synthesis of ammonia in a dielectric barrier discharge reactor

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Table S1. Flow rate of additive gases under various conditions

	H ₂ (mL)	N ₂ (mL)	Ar/He (30%) (mL)	Ar/He (40%) (mL)	Ar/He (50%) (mL)
H₂:N₂ = 5	100	20	50	80	120
H₂:N₂ = 3	90	30	50	80	120
H₂:N₂ = 2	80	40	50	80	120
H₂:N₂ = 1	60	60	50	80	120
H₂:N₂ = 0.5	40	80	50	80	120
H₂:N₂ = 0.33	30	90	50	80	120

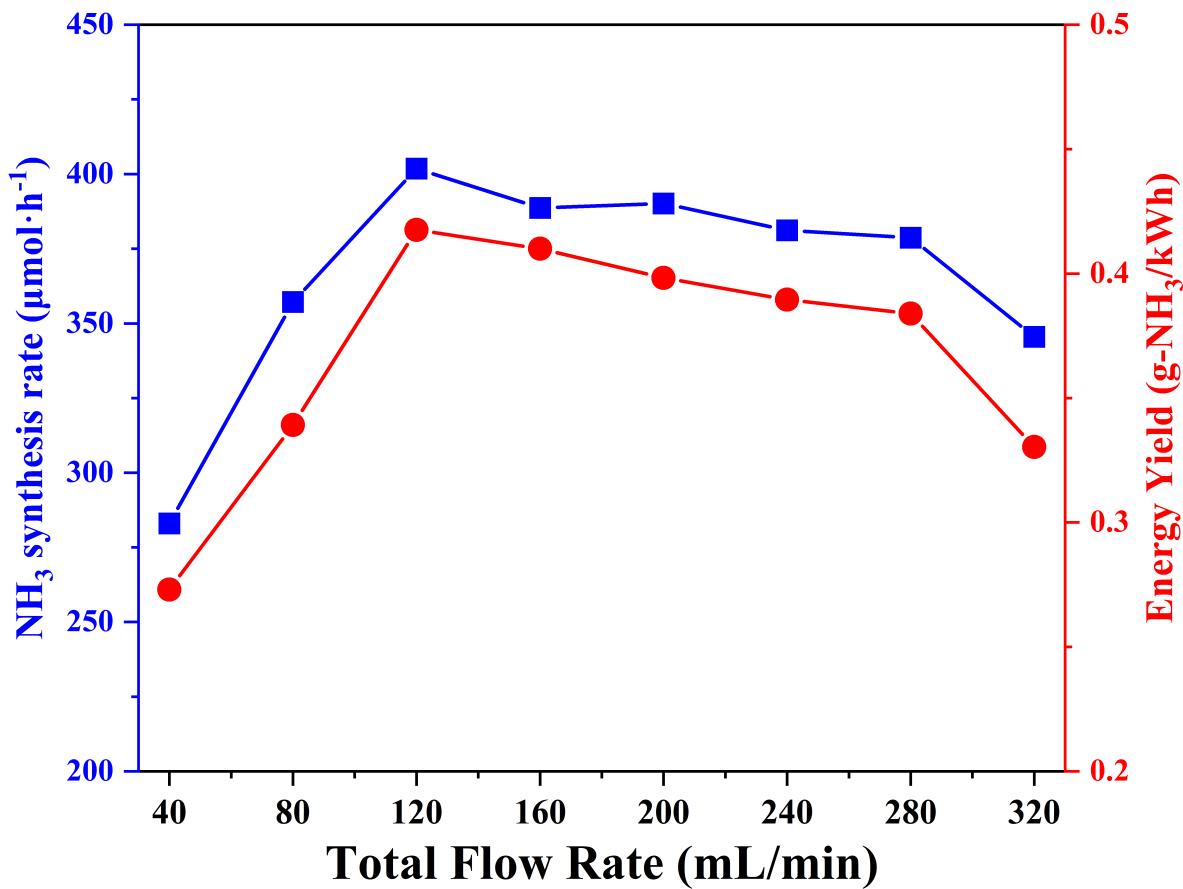


Figure S1. Effect of Gas Flow Rate on Ammonia Synthesis Efficiency

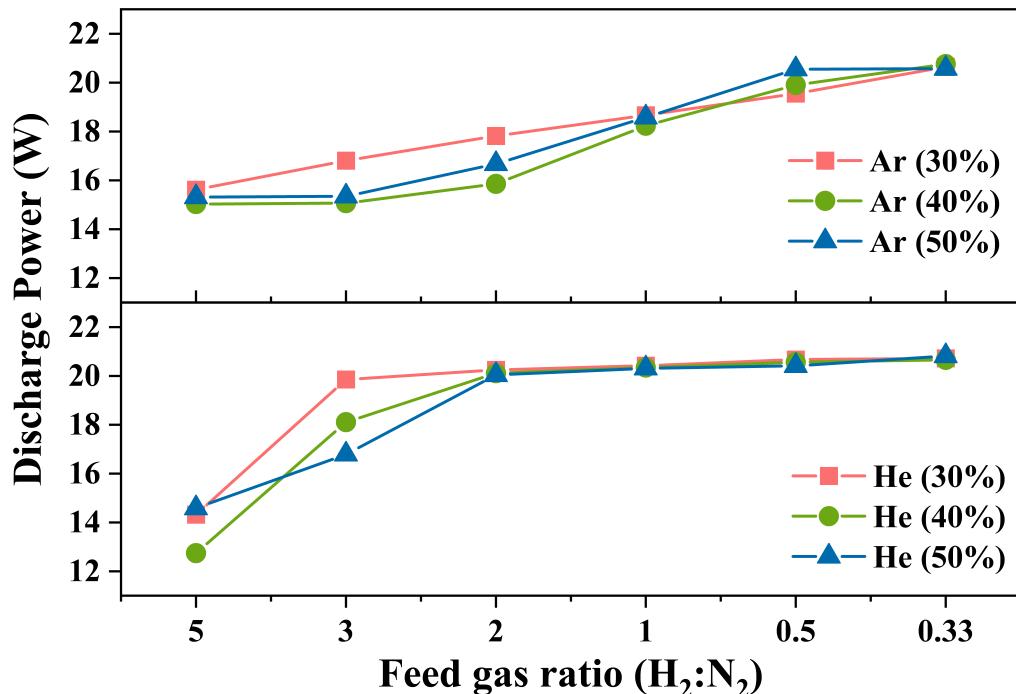


Figure S2. Effect of different Ar and He additions on the discharge power at different gas ratios

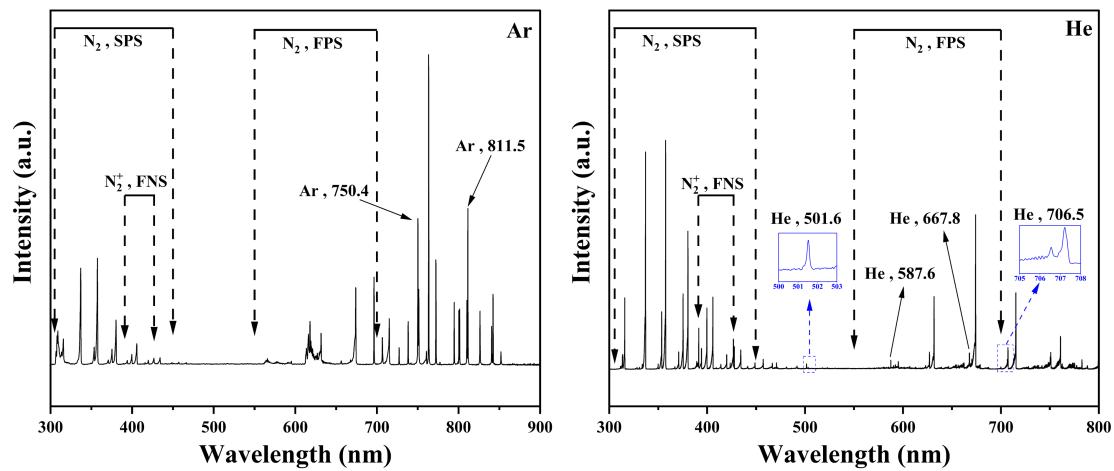


Figure S3. OES plots for the addition of Ar and the addition of He

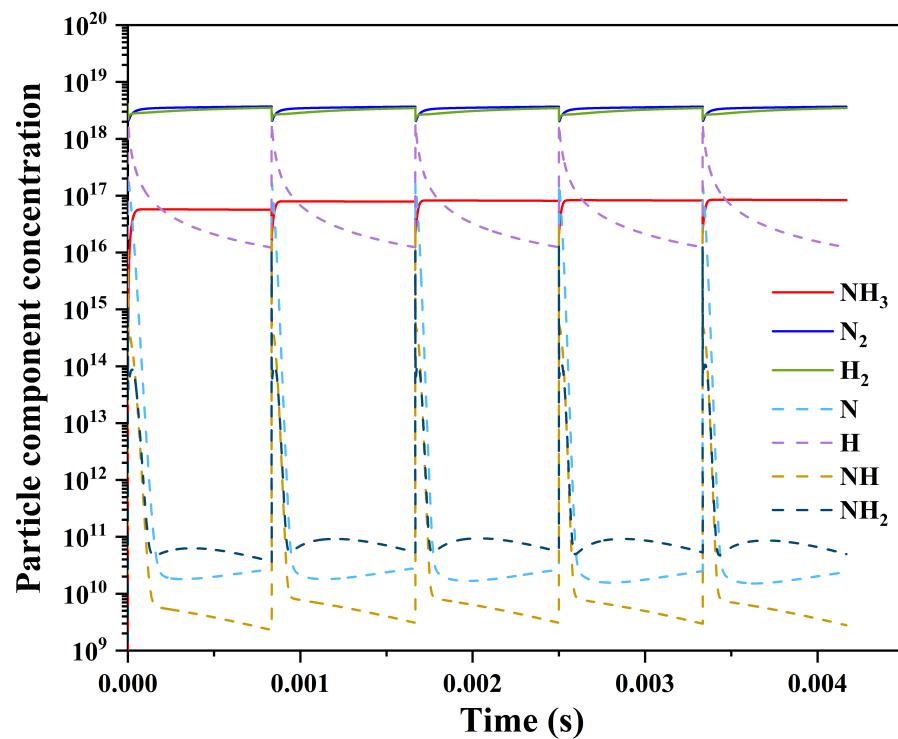


Figure S4. Variation of the density of the main active particles in the reaction as a function of time

Table S2. Species considered in the N₂-H₂-Ar plasma model.

Neutral particles	vibrating particles	excited particles	Charged Particles
N ₂ , H ₂ , N, H, NH, NH ₂ , NH ₃ , Ar	N ₂ (v1), N ₂ (v2), N ₂ (v3), N ₂ (v4), N ₂ (v5), N ₂ (v6), N ₂ (v7), N ₂ (v8), H ₂ (v1), H ₂ (v2), H ₂ (v3)	N ₂ (a'1), N ₂ (C3), N(2D), N(2P), H ₂ (A3), H ₂ (B3), H ₂ (B1), H ₂ (C3) Ar(1S ⁵), Ar(1S ⁴), Ar(1S ³) Ar(1S ²), Ar(2P ¹⁰), Ar(2P ⁹),	e, H ⁻ , N ⁺ , N ₂ ⁺ , N ₃ ⁺ , N ₄ ⁺ , H ⁺ , H ₂ ⁺ , H ₃ ⁺ , NH ⁺ , N ₂ H ⁺ , NH ₂ ⁺ , NH ₃ ⁺ , NH ₄ ⁺ , Ar ⁺ , ArH ⁺

Table S3. Gas-phase reactions

	Reaction	Rate coefficient (cm ³ s ⁻¹)	ref
1	$e + N_2 \rightarrow e + N_2^*$ $N_2^* = N_2(A3), N_2(B3), N_2(a'1), N_2(C3)$	BOLSIG +	[1]
2	$e + H_2 \rightarrow e + H_2$ $H_2 = H_2(B3), H_2(B1), H_2(C3), H_2(A3)$	BOLSIG +	[1]
3	$e + M \rightarrow e + e + M^+$ $M = N_2(X), H_2(X)$	BOLSIG +	[1]
4	$e + N \rightarrow e + e + N^+$	BOLSIG +	[1]
5	$e + H \rightarrow e + e + H^+$	$6.5 \times 10^{-9} \times T_e^{0.99} \times \exp(-12.89/T_e)$	[1]
6	$e + NH \rightarrow e + e + NH^+$	$1.38 \times 10^{-10} \times T_e - 1.85 \times 10^{-10} \times T_e^2$ $+ 6.65 \times 10^{-11} \times T_e^3$ $- 4.36 \times 10^{-12} \times T_e^4$ $+ 3.02 \times 10^{-14} \times T_e^5$	[1]
7	$e + NH_2 \rightarrow e + e + NH_2^+$	$1.76 \times 10^{-10} \times T_e - 2.70 \times 10^{-10} \times T_e^2$ $+ 1.17 \times 10^{-10} \times T_c^3$ $- 1.24 \times 10^{-11} \times T_c^4$ $+ 4.23 \times 10^{-13} \times T_c^5$	[1]
8	$e + NH_3 \rightarrow e + e + NH_3^+$	$1.53 \times 10^{-10} \times T_e - 2.24 \times 10^{-10} \times T_e^2$ $+ 9.37 \times 10^{-11} \times T_e^3$ $- 9.97 \times 10^{-12} \times T_e^4$ $+ 3.33 \times 10^{-13} \times T_e^5$	[1]

9	$e + N_2 \leftrightarrow e + N_2(v_i), 1 \leq i \leq 8$	BOLSIG +	[1]
10	$e + H_2 \leftrightarrow e + H_2(v_j), 1 \leq j \leq 3$	BOLSIG +	[1]
	$N_2(v_i) + M \leftrightarrow N_2(v_i - 1) + M$		
11	$H_2(v_i) + M \leftrightarrow H_2(v_i - 1) + M$ $M = N_2(X), H_2(X), N \text{ and } H$	Vibrational-translational relaxation/excitation	[1]
	$N_2(v_i) + N_2(v_j) \leftrightarrow N_2(v_i - 1) + N_2(v_j + 1)$		
12	$H_2(v_i) + H_2(v_j) \leftrightarrow H_2(v_i - 1) + H_2(v_j + 1)$ $N_2(v_i - 1) + H_2(v_j + 1) \leftrightarrow N_2(v_i) + H_2(v_j)$ $H_2(v_i - 1) + N_2(v_j + 2) \leftrightarrow H_2(v_i) + N_2(v_j)$	Vibrational-vibrational interactions	[1]
13	$N_2(A3) + N_2(v_j \geq 6) \rightarrow N_2(B3) + N_2(v_{j-6})$	3.0×10^{-11}	[1]
14	$N_2(B3) + N_2(v_j, j \geq 0) \rightarrow N_2(A3) + N_2(v_{j+6})$	3.0×10^{-11}	[1]
15	$N_2(B3) \rightarrow N_2(A3)$	1.34×10^5	[1]
16	$N_2(a'1) \rightarrow N_2(X)$	1.0×10^2	[1]
17	$N_2(C3) \rightarrow N_2(B3)$	2.45×10^7	[1]
18	$e + N_2 \rightarrow 2N + e$	BOLSIG +	[1]
19	$e + H_2 \rightarrow 2H + e$	$1.75 \times 10^{-7} \times T_e^{-1.24} \times \exp(-12.59/T_e)$	[1]
20	$e + NH \rightarrow e + N + H$	$5.0 \times 10^{-8} \times T_e^{0.5} \times \exp(-8.6/T_e)$	[1]
21	$e + NH_2 \rightarrow e + N + H_2$	$5.0 \times 10^{-8} \times T_e^{0.5} \times \exp(-7.6/T_e)$	[1]
22	$e + NH_2 \rightarrow e + NH + H$	$5.0 \times 10^{-8} \times T_e^{0.5} \times \exp(-7.6/T_e)$	[1]
23	$e + NH_3 \rightarrow e + NH_2 + H$	$5.0 \times 10^{-8} \times T_e^{0.5} \times \exp(-4.4/T_e)$	[1]
24	$e + NH_3 \rightarrow e + NH + H_2$	$5.0 \times 10^{-8} \times T_e^{0.5} \times \exp(-5.5/T_e)$ $- 5.68 \times 10^{-12} \times T_e + 8.57 \times 10^{-12} \times T_e^2$ $- 4.11 \times 10^{-12} \times T_e^3$ $+ 7.26 \times 10^{-13} \times T_e^4$ $- 3.09 \times 10^{-14} \times T_e^5$	[1]
25	$e + N_2 \rightarrow e + N + N^+$		[1]
26	$e + H_2 \rightarrow e + e + H + H^+$	$3.0 \times 10^{-8} \times T_e^{0.44} \times \exp(-37.72/T_e)$	[1]
27	$e + N_2^+ \rightarrow N + N$	$9.0 \times 10^{-8} \times (0.026/T_e)^{0.39}$	[1]
28	$e + N_2^+ \rightarrow N + N(2D)$	$8.1 \times 10^{-8} \times (0.026/T_e)^{0.39}$	[1]
29	$e + N_2^+ \rightarrow N + N(2P)$	$9.0 \times 10^{-9} \times (0.026/T_e)^{0.39}$	[1]
30	$e + N_3^+ \rightarrow N_2 + N$	$2.0 \times 10^{-7} \times (0.026/T_e)^{0.5}$	[1]
31	$e + N_4^+ \rightarrow N_2 + N_2$	$2.3 \times 10^{-6} \times (0.026/T_e)^{0.53}$	[1]
		$7.51 \times 10^{-9} - 1.12 \times 10^{-9} \times T_e + 1.03 \times 10^{-10} \times T_e^2$	
32	$e + H_2^+ \rightarrow H + H$	$- 4.15 \times 10^{-12} \times T_e^3$ $+ 5.86 \times 10^{-14} \times T_e^4$	[1]

		$4.20 \times 10^{-9} + 1.51 \times 10^{-9} \times T_e + 1.90 \times 10^{-10} \times T_e^2$ + $6.60 \times 10^{-12} \times T_e^3$ + $1.21 \times 10^{-13} \times T_e^4$ - $1.15 \times 10^{-14} \times T_e^5$ + $1.78 \times 10^{-16} \times T_e^6$	
33	$e + H_3^+ \rightarrow H + H + H$	$4.20 \times 10^{-9} + 1.51 \times 10^{-9} \times T_e + 1.90 \times 10^{-10} \times T_e^2$ + $6.60 \times 10^{-12} \times T_e^3$ + $1.21 \times 10^{-13} \times T_e^4$ - $1.15 \times 10^{-14} \times T_e^5$ + $1.78 \times 10^{-16} \times T_e^6$	[1]
34	$e + H_3^+ \rightarrow H_2 + H$	$4.20 \times 10^{-9} + 1.51 \times 10^{-9} \times T_e + 1.90 \times 10^{-10} \times T_e^2$ + $6.60 \times 10^{-12} \times T_e^3$ + $1.21 \times 10^{-13} \times T_e^4$ - $1.15 \times 10^{-14} \times T_e^5$ + $1.78 \times 10^{-16} \times T_e^6$	[1]
35	$e + Ar \rightarrow Ar^+ + e + e$	$3.7 \times 10^{-14} \times T_e^{0.38} \times \exp(-17.64/T_e)$	[2]
36	$e^- + Ar \rightarrow Ar_{meta} + e^-$	$5.0 \times 10^{-15} \times \exp(-12.64/T_e)$	[1]
37	$e + NH^+ \rightarrow N + H$	$4.3 \times 10^{-8} \times (0.026/T_e)^{0.5}$	[1]
38	$e + NH_2^+ \rightarrow NH + H$	$1.02 \times 10^{-7} \times (0.026/T_e)^{0.4}$	[1]
39	$e + NH_2^+ \rightarrow N + 2H$	$1.98 \times 10^{-7} \times (0.026/T_e)^{0.4}$	[1]
40	$e + NH_3^+ \rightarrow NH + 2H$	$1.55 \times 10^{-7} \times (0.026/T_e)^{0.5}$	[1]
41	$e + NH_3^+ \rightarrow NH_2 + H$	$1.55 \times 10^{-7} \times (0.026/T_e)^{0.5}$	[1]
42	$e + NH_4^+ \rightarrow NH_3 + H$	$8.01 \times 10^{-7} \times (0.026/T_e)^{0.605}$	[1]
43	$e + NH_4^+ \rightarrow NH_2 + 2H$	$1.23 \times 10^{-7} \times (0.026/T_e)^{0.605}$	[1]
44	$e + N_2H^+ \rightarrow N_2 + H$	$7.1 \times 10^{-7} \times (0.026/T_e)^{0.72}$	[1]
45	$N_2^+ + H_2 \rightarrow N_2H^+ + H$	2.0×10^{-9}	[1]
46	$N_2^+ + N_2(A3) \rightarrow N_3^+ + N$	3.0×10^{-10}	[1]
47	$N_2^+ + N \rightarrow N^+ + N_2$	$7.2 \times 10^{-13} \times (T_{eff}/300)^{2.2}$	[1]
48	$N_2^+ + N_2 + N \rightarrow N_3^+ + N_2$	$9.0 \times 10^{-30} \times \exp(400/T_{eff})$	[1]
49	$N_2^+ + N_2 + N_2 \rightarrow N_4^+ + N_2$	$5.2 \times 10^{-29} \times (300/T_{eff})^{2.2}$	[1]
50	$N_2^+ + NH_3 \rightarrow NH_3^+ + N_2$	1.95×10^{-9}	[1]
51	$N_3^+ + N \rightarrow N_2^+ + N_2$	6.6×10^{-11}	[1]
52	$N_4^+ + N \rightarrow N^+ + N_2 + N_2$	1.0×10^{-11}	[1]
53	$N_4^+ + N_2 \rightarrow N_2^+ + N_2 + N_2$	$2.1 \times 10^{-16} \times \exp(T_{eff}/121), T_{eff} < 1.7 \times 10^3 \text{ K}$ $5 \times 10^{-10}, T_{eff} \geq 1.7 \times 10^3 \text{ K}$	[1]
54	$N^+ + H_2 \rightarrow NH^+ + H$	5.0×10^{-10}	[1]
55	$N^+ + NH_3 \rightarrow NH_2^+ + NH$	4.7×10^{-10}	[1]
56	$N^+ + NH_3 \rightarrow NH_3^+ + N$	1.67×10^{-9}	[1]
57	$N^+ + NH_3 \rightarrow N_2H^+ + H_2$	2.12×10^{-10}	[1]
58	$H_2^+ + H \rightarrow H_2 + H^+$	6.4×10^{-10}	[1]
59	$H_2^+ + H_2 \rightarrow H_3^+ + H$	2.0×10^{-9}	[1]

60	$\text{H}_2^+ + \text{NH}_3 \rightarrow \text{NH}_3^+ + \text{H}_2$	5.7×10^{-9}	[1]
61	$\text{H}_2^+ + \text{N}_2 \rightarrow \text{N}_2\text{H}^+ + \text{H}$	2.0×10^{-9}	[1]
62	$\text{H}^+ + \text{NH}_3 \rightarrow \text{NH}_3^+ + \text{H}$	5.2×10^{-9}	[1]
63	$\text{NH}^+ + \text{H}_2 \rightarrow \text{H}_3^+ + \text{N}$	1.85×10^{-10}	[1]
64	$\text{NH}^+ + \text{H}_2 \rightarrow \text{NH}_2^+ + \text{H}$	1.05×10^{-9}	[1]
65	$\text{NH}^+ + \text{NH}_3 \rightarrow \text{NH}_3^+ + \text{NH}$	1.8×10^{-9}	[1]
66	$\text{NH}^+ + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{N}$	6.0×10^{-10}	[1]
67	$\text{NH}^+ + \text{N}_2 \rightarrow \text{N}_2\text{H}^+ + \text{N}$	6.5×10^{-10}	[1]
68	$\text{NH}_2^+ + \text{H}_2 \rightarrow \text{NH}_3^+ + \text{H}$	1.95×10^{-10}	[1]
69	$\text{NH}_2^+ + \text{NH}_3 \rightarrow \text{NH}_3^+ + \text{NH}_2$	1.15×10^{-9}	[1]
70	$\text{NH}_2^+ + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{NH}$	1.15×10^{-9}	[1]
71	$\text{NH}_3^+ + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{NH}_2$	2.10×10^{-9}	[1]
72	$\text{N}_2\text{H}^+ + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{N}_2$	2.3×10^{-9}	[1]
73	$\text{ArH}^+ + \text{H}_2 \rightarrow \text{H}_3^+ + \text{Ar}$	6.3×10^{-16}	[2]
74	$\text{H}_2^+ + \text{Ar} \rightarrow \text{ArH}^+ + \text{H}$	2.1×10^{-15}	[2]
75	$\text{H}_2^+ + \text{Ar} \rightarrow \text{Ar}^+ + \text{H}_2$	2.0×10^{-16}	[2]
76	$\text{H}_3^+ + \text{Ar} \rightarrow \text{ArH}^+ + \text{H}_2$	3.7×10^{-16}	[2]
77	$\text{Ar}^+ + \text{H}_2 \rightarrow \text{ArH}^+ + \text{H}$	8.7×10^{-16}	[2]
78	$\text{Ar}^+ + \text{H}_2 \rightarrow \text{H}_2^+ + \text{Ar}$	1.8×10^{-17}	[2]
79	$\text{Ar}^+ + \text{N}_2 \rightarrow \text{N}_2^+ + \text{Ar}$	1.1×10^{-17}	[2]
80	$\text{N}_2^+ + \text{Ar} \rightarrow \text{Ar}^+ + \text{N}_2$	2.0×10^{-19}	[2]
81	$\text{Ar}^+ + \text{NH}_2 \rightarrow \text{NH}^+ + \text{H} + \text{Ar}$	5.5×10^{-17}	[2]
82	$\text{Ar}^+ + \text{NH}_3 \rightarrow \text{NH}_3^+ + \text{Ar}$	1.6×10^{-15}	[2]
83	$\text{ArH}^+ + \text{NH}_3 \rightarrow \text{NH}_3^+ + \text{H} + \text{Ar}$	5.3×10^{-16}	[2]
84	$\text{ArH}^+ + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{Ar}$	1.6×10^{-15}	[2]
85	$\text{ArH}^+ + \text{N}_2 \rightarrow \text{N}_2\text{H}^+ + \text{Ar}$	8.0×10^{-16}	[2]
86	$\text{Ar}^+ + \text{NH}_3 \rightarrow \text{NH}_2^+ + \text{H} + \text{Ar}$	5.5×10^{-17}	[2]
87	$\text{Ar}^+ + \text{NH}_3 \rightarrow \text{ArH}^+ + \text{NH}_2$	9.2×10^{-17}	[2]
88	$\text{N}_2(\text{A}3) + \text{N} \rightarrow \text{N}_2 + \text{N}$	2.0×10^{-12}	[1]
89	$\text{N}_2(\text{A}3) + \text{N} \rightarrow \text{N}_2 + \text{N}(2\text{P})$	$4.0 \times 10^{-11} (300/T_{\text{g}})^{2/3}$	[1]
90	$\text{N}_2(\text{A}3) + \text{N}_2 \rightarrow \text{N}_2 + \text{N}_2$	3.0×10^{-16}	[1]

91	$\text{N}_2(A3) + \text{N}_2(A3) \rightarrow \text{N}_2 + \text{N}_2(B3)$	3.0×10^{-10}	[1]
92	$\text{N}_2(A3) + \text{N}_2(A3) \rightarrow \text{N}_2 + 2 \text{ N}$	3.0×10^{-11}	[1]
93	$\text{N}_2(A3) + \text{N}_2(X, v \geq 6) \rightarrow \text{N}_2(B3) + \text{N}_2$	3.0×10^{-11}	[1]
94	$\text{N}_2(B3) + \text{N}_2 \rightarrow \text{N}_2(A3) + \text{N}_2$	3.0×10^{-11}	[1]
95	$\text{N}_2(B3) + \text{N}_2 \rightarrow \text{N}_2 + \text{N}_2$	2.0×10^{-12}	[1]
96	$\text{N}_2(a'1) + \text{N}_2 \rightarrow \text{N}_2(B3) + \text{N}_2$	1.9×10^{-13}	[1]
97	$\text{N}_2(a'1) + \text{N}_2(a'1) \rightarrow \text{N}_2^+ + \text{N}_2 + e$	1.0×10^{-11}	[1]
98	$\text{N}_2(a'1) + \text{N}_2(A3) \rightarrow \text{N}_4^+ + e$	4.0×10^{-12}	[1]
99	$\text{N}(2\text{D}) + \text{N}_2 \rightarrow \text{N} + \text{N}_2$	$2.3 \times 10^{-14} \times \exp(-510/T_g)$	[1]
100	$\text{N}(2\text{P}) + \text{N} \rightarrow \text{N} + \text{N}$	1.8×10^{-12}	[1]
101	$\text{N}(2\text{P}) + \text{N} \rightarrow \text{N}(2\text{D}) + \text{N}$	6.0×10^{-13}	[1]
102	$\text{N}(2\text{P}) + \text{N}_2 \rightarrow \text{N} + \text{N}_2$	6.0×10^{-14}	[1]
103	$\text{N}_2(A3) + \text{H} \rightarrow \text{N}_2 + \text{H}$	5.0×10^{-11}	[1]
104	$\text{N}_2(A3) + \text{H}_2 \rightarrow \text{N}_2 + 2\text{H}$	$2.0 \times 10^{-10} \times \exp(-3500/T_g)$	[1]
105	$\text{N}_2(A3) + \text{NH}_3 \rightarrow \text{N}_2 + \text{NH}_3$	1.6×10^{-10}	[1]
106	$\text{N}_2(B3) + \text{H}_2 \rightarrow \text{N}_2(A3) + \text{H}_2$	2.5×10^{-11}	[1]
107	$\text{N}_2(a'1) + \text{H} \rightarrow \text{N}_2 + \text{H}$	1.5×10^{-11}	[1]
108	$\text{N}_2(a'1) + \text{H}_2 \rightarrow \text{N}_2 + \text{H}_2$	2.6×10^{-11}	[1]
109	$\text{N} + \text{H}_2(v) \rightarrow \text{H} + \text{NH}$	$4 \times 10^{-10} \times \left(\frac{T_g}{300}\right)^{0.5} \exp\left(-\frac{E_a}{T_g} + \frac{0.3E_v}{T_g}\right)$ $0.3E_v \leq E_a = 16600 \text{ K}$	[1]
110	$\text{N}(2\text{D}) + \text{H}_2 \rightarrow \text{H} + \text{NH}$	2.3×10^{-12}	[1]
111	$\text{N}(2\text{D}) + \text{NH}_3 \rightarrow \text{NH} + \text{NH}_2$	1.1×10^{-10}	[1]
112	$\text{N}(2\text{P}) + \text{H}_2 \rightarrow \text{H} + \text{NH}$	2.5×10^{-14}	[1]
113	$\text{N} + \text{NH} \rightarrow \text{H} + \text{N}_2$	5.0×10^{-11}	[1]
114	$\text{H} + \text{NH} \rightarrow \text{H}_2 + \text{N}$	$5.4 \times 10^{-11} \times \exp(-165/T_g)$	[1]
115	$\text{NH} + \text{NH} \rightarrow \text{H}_2 + \text{N}_2$	$5.0 \times 10^{-14} \times (T_g/300)$	[1]
116	$\text{NH} + \text{NH} \rightarrow \text{N} + \text{NH}_2$	$1.7 \times 10^{-12} \times (T_g/300)^{1.5}$	[1]
117	$\text{NH} + \text{NH} \rightarrow \text{N}_2 + 2\text{H}$	8.5×10^{-11}	[1]
118	$\text{H} + \text{NH}_2 \rightarrow \text{H}_2 + \text{NH}$	$6.6 \times 10^{-11} \times \exp(-1840/T_g)$	[1]
119	$\text{N} + \text{NH}_2 \rightarrow \text{N}_2 + 2\text{H}$	1.2×10^{-10}	[1]
120	$\text{N} + \text{NH}_2 \rightarrow \text{N}_2 + \text{H}_2$	1.2×10^{-10}	[1]
121	$\text{NH} + \text{NH}_2 \rightarrow \text{NH}_3 + \text{N}$	1.66×10^{-12}	[1]
122	$\text{H}_2 + \text{NH}_2 \rightarrow \text{NH}_3 + \text{H}$	$5.4 \times 10^{-11} \times \exp(-6492/T_g)$	[1]
123	$\text{H} + \text{NH}_3 \rightarrow \text{NH}_2 + \text{H}_2$	$8.4 \times 10^{-14} \times (T_g/300)^{4.1} \exp(-4760/T_g)$	[1]

124	$\text{Ar}_{meta} + \text{H}_2 \rightarrow 2\text{H} + \text{Ar}$	1.1×10^{-16}	[1]
125	$\text{Ar}_{meta} + \text{N}_2 \rightarrow \text{N}_2(\text{C}) + \text{Ar}$	3.0×10^{-17}	[1]
126	$\text{N} + \text{N} + \text{M} \rightarrow \text{N}_2(\text{A3}) + \text{M}$ $\text{M} = \text{N}_2, \text{H}_2$	4.4×10^{-36}	[1]
127	$\text{N} + \text{N} + \text{M} \rightarrow \text{N}_2(\text{A3}) + \text{M}$ $\text{M} = \text{N}, \text{H}$	2.6×10^{-35}	[1]
128	$\text{N} + \text{N} + \text{M} \rightarrow \text{N}_2(\text{B3}) + \text{M}$ $\text{M} = \text{N}_2, \text{H}_2$	6.2×10^{-36}	[1]
129	$\text{N} + \text{N} + \text{M} \rightarrow \text{N}_2(\text{B3}) + \text{M}$ $\text{M} = \text{N}, \text{H}$	3.6×10^{-35}	[1]
130	$\text{N} + \text{N} + \text{M} \rightarrow \text{N}_2 + \text{M}$ $\text{M} = \text{N}_2, \text{H}_2$	$2.4 \times 10^{-36} \times \exp(500/T_g)$	[1]
131	$\text{H} + \text{H} + \text{N}_2 \rightarrow \text{H}_2 + \text{N}_2$	$2.2 \times 10^{-35} \times (300/T_2)$	[1]
132	$\text{N} + \text{H} + \text{M} \rightarrow \text{NH} + \text{M}$ $\text{M} = \text{N}_2, \text{H}_2$	2.6×10^{-36}	[1]
133	$\text{N} + \text{H}_2 + \text{M} \rightarrow \text{NH}_2 + \text{M}$ $\text{M} = \text{N}_2, \text{H}_2$	2.6×10^{-37}	[1]
134	$\text{N} + \text{NH} + \text{M} \rightarrow \text{NH}_2 + \text{M}$ $\text{M} = \text{N}_2, \text{H}_2$	2.6×10^{-35}	[1]
135	$\text{H} + \text{NH}_2 + \text{M} \rightarrow \text{NH}_3 + \text{M}$ $\text{M} = \text{N}_2, \text{H}_2$	1.4×10^{-32}	[1]
136	$\text{NH} + \text{H}_2 + \text{M} \rightarrow \text{NH}_3 + \text{M}$ $\text{M} = \text{N}_2, \text{H}_2$	$6.5 \times 10^{-38} \times (T_8/300) \exp(1700/T_8)$	[1]
137	$e + \text{H}_2 \rightarrow \text{H} + \text{H}^-$	BOLSIG +	[1]
138	$\text{H}^- + \text{H}_2^+ \rightarrow 3\text{H}$	$2 \times 10^{-7} (300/T_2)$	[1]
139	$\text{H}^- + \text{H}_3^+ \rightarrow \text{H}_2 + 2\text{H}$	$2 \times 10^{-7} (300/T_g)$	[1]
140	$\text{H}^- + \text{N}_2^+ \rightarrow \text{N}_2 + \text{H}$	$2 \times 10^{-7} (300/T_k)$	[1]

141	$H^- + N_4^+ \rightarrow 2 N_2 + H$	$2 \times 10^{-7} (300/T_2)$	[1]
142	$H^- + N_2H^+ \rightarrow H_2 + N_2$	$2 \times 10^{-7} (300/T_2)$	[1]
143	$H^- + H_2^+ + M \rightarrow H_2 + H + M$	$5 \times 10^{-28} (300/T_2)^{2.5}$	[1]
144	$H^- + H_3^+ + M \rightarrow 2H_2 + M$	$5 \times 10^{-28} (300/T_8)^{2.5}$	[1]
145	$H^- + N_2^+ + M \rightarrow N_2 + H + M$	$5 \times 10^{-28} (300/T_8)^{2.5}$	[1]
146	$H^- + N_4^+ + M \rightarrow 2 N_2 + H + M$	$5 \times 10^{-28} (300/T_2)^{2.5}$	[1]
147	$H^- + N_2H^+ + M \rightarrow H_2 + N_2 + M$ $M = N_2, H_2$	$5 \times 10^{-28} (300/T_8)^{2.5}$	[1]

For the reaction rates of chemical equations 11 and 12, we used the calculation method introduced by Hong et al. in Section 2.1 and obtained the corresponding reaction rates.

References

1. Hong, J.; Pancheshnyi, S.; Tam, E.; Lowke, J.J.; Prawer, S.; Murphy, A.B. Kinetic Modelling of NH₃ Production in N₂-H₂ Non-Equilibrium Atmospheric-Pressure Plasma Catalysis. *J. Phys. D: Appl. Phys.* **2017**, *50*, 154005, doi:10.1088/1361-6463/aa6229.
2. Sode, M.; Jacob, W.; Schwarz-Selinger, T.; Kersten, H. Measurement and Modeling of Neutral, Radical, and Ion Densities in H₂-N₂-Ar Plasmas. *Journal of Applied Physics* **2015**, *117*, doi:10.1063/1.4913623.