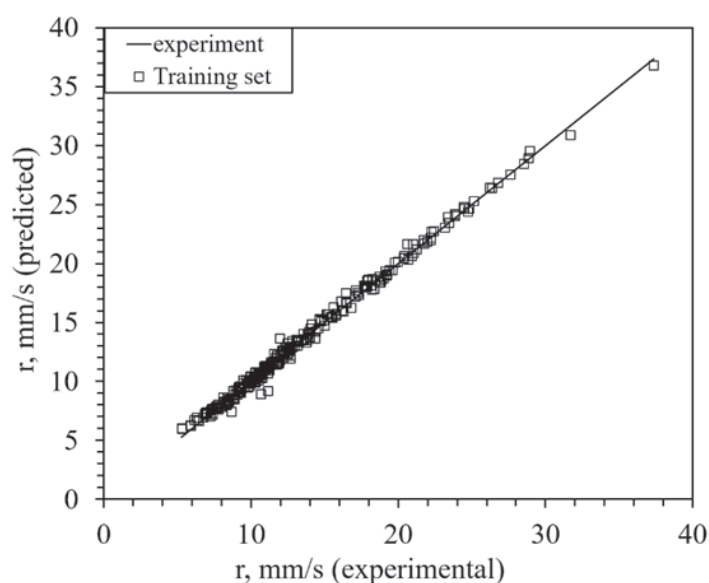


## Recent Advancements in Study of Effects of Nano/Micro Additives on Solid Propellants Combustion by Means of the Data Science Methods

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### Appendix I



Supplementary Figure S1. Training set scatter graph of experimental  $r$  vs ANN predicted  $r$  for ANN model 1.

Supplementary Table S1. Training dataset used to train ANN model 1

S. No	Name	Binder	AP %	Binder %	Al %	Al size (um)	AP SSA (m <sup>2</sup> /gm)	Fe <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> SSA (m <sup>2</sup> /gm)	P, bar	r, mm/s	ANN r, mm/s
1	LCA-8907-1	HTPB	78	12	10	15	4030	0	0	23.65	6.88	7.33
2	LCA-8907-1	HTPB	78	12	10	15	4030	0	0	27.85	7.52	7.64
3	LCA-8907-1	HTPB	78	12	10	15	4030	0	0	29.44	7.67	7.76
4	LCA-8907-1	HTPB	78	12	10	15	4030	0	0	44.20	8.79	8.84
5	LCA-8907-1	HTPB	78	12	10	15	4030	0	0	48.40	9.12	9.12
6	LCA-8907-1	HTPB	78	12	10	15	4030	0	0	50.19	8.94	9.24
7	LCA-8907-1	HTPB	78	12	10	15	4030	0	0	51.02	9.25	9.29
8	LCA-8907-1	HTPB	78	12	10	15	4030	0	0	115.90	12.47	13.25
9	LCA-8910-1	HTPB	78	12	10	15	1503	0	0	23.79	5.28	5.99
10	LCA-8910-1	HTPB	78	12	10	15	1503	0	0	25.92	5.31	6.06

Supplementary Table S1. Training dataset used to train ANN model 1

S. No	Name	Binder	AP %	Binder %	Al %	Al size (um)	AP SSA (m <sup>2</sup> /gm)	Fe <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> SSA (m <sup>2</sup> /gm)	P, bar	r, mm/s	ANN r, mm/s
11	LCA-8910-1	HTPB	78	12	10	15	1503	0	0	32.06	5.87	6.28
12	LCA-8910-1	HTPB	78	12	10	15	1503	0	0	41.71	6.45	6.64
13	LCA-8910-1	HTPB	78	12	10	15	1503	0	0	56.61	7.37	7.2
14	LCA-8910-1	HTPB	78	12	10	15	1503	0	0	81.01	8.33	7.98
15	LCA-8910-1	HTPB	78	12	10	15	1503	0	0	121.83	9.30	9.03
16	LCA-8910-1	HTPB	78	12	10	15	1503	0	0	153.20	9.65	10.15
17	LCA-8926C-2	HTPB	78	12	10	15	2690	0	0	26.27	7.21	7.05
18	LCA-8926C-2	HTPB	78	12	10	15	2690	0	0	38.20	7.98	7.86
19	LCA-8926C-2	HTPB	78	12	10	15	2690	0	0	41.44	8.26	8.08
20	LCA-8926C-2	HTPB	78	12	10	15	2690	0	0	45.23	8.48	8.33
21	LCA-8926C-2	HTPB	78	12	10	15	2690	0	0	58.19	9.14	9.12
22	LCA-8926C-2	HTPB	78	12	10	15	2690	0	0	76.39	9.83	10.02
23	LCA-8926C-2	HTPB	78	12	10	15	2690	0	0	105.97	11.02	11.11
24	LCA-8926C-2	HTPB	78	12	10	15	2690	0	0	117.62	11.35	11.48
25	LCA-8911Y-2	HTPB	78	12	10	15	5257	0	0	47.30	9.91	9.9
26	LCA-8911Y-2	HTPB	78	12	10	15	5257	0	0	47.30	10.03	9.9
27	LCA-8911Y-2	HTPB	78	12	10	15	5257	0	0	59.29	11.00	10.94
28	LCA-8911Y-2	HTPB	78	12	10	15	5257	0	0	62.74	10.97	11.23
29	LCA-8911Y-2	HTPB	78	12	10	15	5257	0	0	71.29	11.66	11.93
30	LCA-8926X-3	HTPB	76	12	10	15	2756	2	10	24.75	9.91	9.58
31	LCA-8926X-3	HTPB	76	12	10	15	2756	2	10	37.09	11.76	11.51
32	LCA-8926X-3	HTPB	76	12	10	15	2756	2	10	42.82	12.50	12.37
33	LCA-8926X-3	HTPB	76	12	10	15	2756	2	10	66.05	14.76	15.09
34	LCA-8926X-3	HTPB	76	12	10	15	2756	2	10	73.43	15.27	15.72
35	LCA-8926X-3	HTPB	76	12	10	15	2756	2	10	88.74	16.41	16.81
36	LCA-8926X-3	HTPB	76	12	10	15	2756	2	10	119.69	18.85	18.6
37	LCA-8926X-3	HTPB	76	12	10	15	2756	2	10	126.93	19.20	19.01
38	LCA-8926-1	HTPB	76	12	10	15	2756	2	3	23.44	8.94	8.876
39	LCA-8926-1	HTPB	76	12	10	15	2756	2	3	33.99	10.36	10.29
40	LCA-8926-1	HTPB	76	12	10	15	2756	2	3	38.82	10.87	10.93
41	LCA-8926-1	HTPB	76	12	10	15	2756	2	3	64.05	13.08	13.53
42	LCA-8926-1	HTPB	76	12	10	15	2756	2	3	71.29	13.54	14.04
43	LCA-8926-1	HTPB	76	12	10	15	2756	2	3	94.73	14.94	15.22
44	LCA-8926-1	HTPB	76	12	10	15	2756	2	3	122.24	16.79	16.23
45	LCA-8911-1	HTPB	77.2	12	10	15	5311	0.8	8.4	56.47	23.42	23.47
46	LCA-8911-1	HTPB	77.2	12	10	15	5311	0.8	8.4	81.15	26.75	26.84
47	LCA-8911-1	HTPB	77.2	12	10	15	5311	0.8	8.4	97.49	28.52	28.47
48	LCA-8911-1	HTPB	77.2	12	10	15	5311	0.8	8.4	128.79	31.67	30.91
49	LCA-8911-1	HTPB	77.2	12	10	15	5311	0.8	8.4	185.40	37.34	36.8
50	LCA-8911Z-4	HTPB	76	12	10	15	5393	2	3	30.75	17.07	17.21
51	LCA-8911Z-4	HTPB	76	12	10	15	5393	2	3	36.68	18.24	18.71
52	LCA-8911Z-4	HTPB	76	12	10	15	5393	2	3	53.99	22.17	22.19
53	LCA-8911Z-4	HTPB	76	12	10	15	5393	2	3	69.77	24.71	24.41

Supplementary Table S1. Training dataset used to train ANN model 1

S. No	Name	Binder	AP %	Binder %	Al %	Al size (um)	AP SSA (m <sup>2</sup> /gm)	Fe <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> SSA (m <sup>2</sup> /gm)	P, bar	r, mm/s	ANN r, mm/s
54	LCA-8911Z-4	HTPB	76	12	10	15	5393	2	3	77.70	25.12	25.3
55	LCA-8911Z-4	HTPB	76	12	10	15	5393	2	3	88.94	26.34	26.42
56	LCA-8911Z-4	HTPB	76	12	10	15	5393	2	3	89.22	26.21	26.44
57	LCA-8911Z-4	HTPB	76	12	10	15	5393	2	3	128.66	28.93	29.55
58	LCA-8911X-3	HTPB	77.6	12	10	15	5284	0.4	9.4	27.79	13.87	13.93
59	LCA-8911X-3	HTPB	77.6	12	10	15	5284	0.4	9.4	45.16	18.19	17.8
60	LCA-8911X-3	HTPB	77.6	12	10	15	5284	0.4	9.4	68.26	20.57	21.67
61	LCA-8911X-3	HTPB	77.6	12	10	15	5284	0.4	9.4	76.26	22.38	22.74
62	LCA-8911X-3	HTPB	77.6	12	10	15	5284	0.4	9.4	78.67	23.14	23.04
63	LCA-8911X-3	HTPB	77.6	12	10	15	5284	0.4	9.4	92.67	24.49	24.65
64	LCA-8911X-3	HTPB	77.6	12	10	15	5284	0.4	9.4	123.00	27.61	27.53
65	LCA-8911X-3	HTPB	77.6	12	10	15	5284	0.4	9.4	138.72	28.83	28.93
66	LCA-8904X-2	HTPB	77.5	12	10	15	3985	0.5	26.4	16.62	8.08	8.67
67	LCA-8904X-2	HTPB	77.5	12	10	15	3985	0.5	26.4	27.51	10.62	10.34
68	LCA-8904X-2	HTPB	77.5	12	10	15	3985	0.5	26.4	49.85	14.00	13.69
69	LCA-8904X-2	HTPB	77.5	12	10	15	3985	0.5	26.4	67.71	15.80	15.74
70	LCA-8904X-2	HTPB	77.5	12	10	15	3985	0.5	26.4	93.77	17.81	18
71	LCA-8904X-2	HTPB	77.5	12	10	15	3985	0.5	26.4	96.04	17.68	18.17
72	LCA-8904X-2	HTPB	77.5	12	10	15	3985	0.5	26.4	145.07	21.72	22
73	LCA-8908X-2	HTPB	77	12	10	15	1520	1	5.1	37.51	8.86	8.48
74	LCA-8908X-2	HTPB	77	12	10	15	1520	1	5.1	49.23	9.78	9.49
75	LCA-8908X-2	HTPB	77	12	10	15	1520	1	5.1	55.36	10.29	9.97
76	LCA-8908X-2	HTPB	77	12	10	15	1520	1	5.1	71.43	11.20	10.97
77	LCA-8908X-2	HTPB	77	12	10	15	1520	1	5.1	84.39	11.79	11.58
78	LCA-8908X-2	HTPB	77	12	10	15	1520	1	5.1	90.32	11.94	11.82
79	LCA-8908X-2	HTPB	77	12	10	15	1520	1	5.1	94.11	12.19	11.96
80	LCA-8908X-2	HTPB	77	12	10	15	1520	1	5.1	146.86	14.00	13.8
81	LCA-8906X-2	HTPB	77	12	10	15	3985	1	9.2	55.23	16.13	16.02
82	LCA-8906X-2	HTPB	77	12	10	15	3985	1	9.2	65.71	17.32	17.33
83	LCA-8906X-2	HTPB	77	12	10	15	3985	1	9.2	85.63	19.10	19.35
84	LCA-8906X-2	HTPB	77	12	10	15	3985	1	9.2	94.73	19.96	20.15
85	LCA-8906X-2	HTPB	77	12	10	15	3985	1	9.2	148.10	24.43	24.81
86	LCA-8909Y-3	HTPB	76.5	12	10	15	1530	1.5	3	31.72	8.26	8.22
87	LCA-8909Y-3	HTPB	76.5	12	10	15	1530	1.5	3	33.99	8.36	8.44
88	LCA-8909Y-3	HTPB	76.5	12	10	15	1530	1.5	3	51.50	9.91	10.07
89	LCA-8909Y-3	HTPB	76.5	12	10	15	1530	1.5	3	59.23	10.49	10.67
90	LCA-8909Y-3	HTPB	76.5	12	10	15	1530	1.5	3	67.71	11.07	11.21
91	LCA-8909Y-3	HTPB	76.5	12	10	15	1530	1.5	3	91.22	11.99	12.28
92	LCA-8908-1	HTPB	76.5	12	10	15	1330	1.5	5.1	21.10	7.01	7.22
93	LCA-8908-1	HTPB	76.5	12	10	15	1330	1.5	5.1	27.99	7.95	7.83
94	LCA-8908-1	HTPB	76.5	12	10	15	1330	1.5	5.1	49.85	10.21	9.92
95	LCA-8908-1	HTPB	76.5	12	10	15	1330	1.5	5.1	58.67	10.77	10.61
96	LCA-8908-1	HTPB	76.5	12	10	15	1330	1.5	5.1	74.26	11.89	11.57

Supplementary Table S1. Training dataset used to train ANN model 1

S. No	Name	Binder	AP %	Binder %	Al %	Al size (um)	AP SSA (m <sup>2</sup> /gm)	Fe <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> SSA (m <sup>2</sup> /gm)	P, bar	r, mm/s	ANN r, mm/s
97	LCA-8908-1	HTPB	76.5	12	10	15	1330	1.5	5.1	93.29	12.45	12.38
98	LCA-8908-1	HTPB	76.5	12	10	15	1330	1.5	5.1	136.45	14.33	13.66
99	LCA-8908Y-3	HTPB	77	12	10	15	1520	1	9.4	36.61	9.04	8.92
100	LCA-8908Y-3	HTPB	77	12	10	15	1520	1	9.4	53.85	10.49	10.56
101	LCA-8908Y-3	HTPB	77	12	10	15	1520	1	9.4	60.33	10.90	11.07
102	LCA-8908Y-3	HTPB	77	12	10	15	1520	1	9.4	75.08	11.66	12.01
103	LCA-8908Y-3	HTPB	77	12	10	15	1520	1	9.4	95.08	12.57	12.95
104	LCA-8908Y-3	HTPB	77	12	10	15	1520	1	9.4	135.34	14.02	14.48
105	LCA-8909-1	HTPB	76.5	12	10	15	1530	1.5	3.9	20.13	6.86	7.25
106	LCA-8909-1	HTPB	76.5	12	10	15	1530	1.5	3.9	26.54	7.70	7.82
107	LCA-8909-1	HTPB	76.5	12	10	15	1530	1.5	3.9	39.23	9.09	9.086
108	LCA-8909-1	HTPB	76.5	12	10	15	1530	1.5	3.9	50.12	10.52	10.11
109	LCA-8909-1	HTPB	76.5	12	10	15	1530	1.5	3.9	57.02	10.46	10.67
110	LCA-8909-1	HTPB	76.5	12	10	15	1530	1.5	3.9	72.39	11.33	11.65
111	LCA-8909-1	HTPB	76.5	12	10	15	1530	1.5	3.9	92.25	12.32	12.51
112	LCA-8909-1	HTPB	76.5	12	10	15	1530	1.5	3.9	127.90	13.56	13.58
113	LCA-8909X-2	HTPB	76.5	12	10	15	1530	1.5	3.7	22.06	6.96	7.4
114	LCA-8909X-2	HTPB	76.5	12	10	15	1530	1.5	3.7	22.61	8.66	7.44
115	LCA-8909X-2	HTPB	76.5	12	10	15	1530	1.5	3.7	26.41	7.59	7.79
116	LCA-8909X-2	HTPB	76.5	12	10	15	1530	1.5	3.7	44.61	9.22	9.58
117	LCA-8909X-2	HTPB	76.5	12	10	15	1530	1.5	3.7	53.92	9.98	10.39
118	LCA-8909X-2	HTPB	76.5	12	10	15	1530	1.5	3.7	67.91	10.92	11.36
119	LCA-8909X-2	HTPB	76.5	12	10	15	1530	1.5	3.7	84.74	11.73	12.19
120	LCA-8909X-2	HTPB	76.5	12	10	15	1530	1.5	3.7	124.80	13.39	13.44
121	LCA-8904-1	HTPB	77	12	10	15	3985	1	26.4	21.17	10.77	10.72
122	LCA-8904-1	HTPB	77	12	10	15	3985	1	26.4	30.06	12.17	12.53
123	LCA-8904-1	HTPB	77	12	10	15	3985	1	26.4	35.03	13.56	13.53
124	LCA-8904-1	HTPB	77	12	10	15	3985	1	26.4	45.71	15.44	15.49
125	LCA-8904-1	HTPB	77	12	10	15	3985	1	26.4	63.50	17.73	18.09
126	LCA-8904-1	HTPB	77	12	10	15	3985	1	26.4	84.67	20.68	20.34
127	LCA-8904-1	HTPB	77	12	10	15	3985	1	26.4	91.08	21.03	20.91
128	LCA-8904-1	HTPB	77	12	10	15	3985	1	26.4	131.41	23.83	24.05
129	LCA-8905-1	HTPB	77	12	10	15	3985	1	3.9	27.17	10.41	10.38
130	LCA-8905-1	HTPB	77	12	10	15	3985	1	3.9	34.13	11.76	11.47
131	LCA-8905-1	HTPB	77	12	10	15	3985	1	3.9	48.54	13.79	13.49
132	LCA-8905-1	HTPB	77	12	10	15	3985	1	3.9	54.88	14.40	14.24
133	LCA-8905-1	HTPB	77	12	10	15	3985	1	3.9	57.02	14.53	14.48
134	LCA-8905-1	HTPB	77	12	10	15	3985	1	3.9	81.43	16.48	16.66
135	LCA-8905-1	HTPB	77	12	10	15	3985	1	3.9	102.94	18.14	18.13
136	LCA-8905-1	HTPB	77	12	10	15	3985	1	3.9	114.87	18.72	18.88
137	LCA-8972-1	CTPB	81	14	5	5	2394	0	0	18.20	5.89	6.27
138	LCA-8972-1	CTPB	81	14	5	5	2394	0	0	29.92	7.39	7.35
139	LCA-8972-1	CTPB	81	14	5	5	2394	0	0	33.37	7.77	7.63

Supplementary Table S1. Training dataset used to train ANN model 1

S. No	Name	Binder	AP %	Binder %	Al %	Al size (um)	AP SSA (m <sup>2</sup> /gm)	Fe <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> SSA (m <sup>2</sup> /gm)	P, bar	r, mm/s	ANN r, mm/s
140	LCA-8972-1	CTPB	81	14	5	5	2394	0	0	47.85	8.79	8.62
141	LCA-8972-1	CTPB	81	14	5	5	2394	0	0	55.50	9.27	9.05
142	LCA-8972-1	CTPB	81	14	5	5	2394	0	0	78.19	10.74	10.29
143	LCA-8972-1	CTPB	81	14	5	5	2394	0	0	85.22	11.13	10.71
144	LCA-8966-1	CTPB	81	14	5	5	3200	0	0	37.92	9.04	9.08
145	LCA-8966-1	CTPB	81	14	5	5	3200	0	0	46.75	9.75	9.83
146	LCA-8966-1	CTPB	81	14	5	5	3200	0	0	49.92	9.86	10.07
147	LCA-8966-1	CTPB	81	14	5	5	3200	0	0	66.05	11.13	11.25
148	LCA-8966-1	CTPB	81	14	5	5	3200	0	0	82.39	12.32	12.47
149	LCA-8966-1	CTPB	81	14	5	5	3200	0	0	103.90	13.92	14.21
150	LCA-8956-1	CTPB	81	14	5	5	5599	0	0	32.41	9.45	10.08
151	LCA-8956-1	CTPB	81	14	5	5	5599	0	0	38.68	10.26	10.73
152	LCA-8956-1	CTPB	81	14	5	5	5599	0	0	46.88	11.30	11.44
153	LCA-8956-1	CTPB	81	14	5	5	5599	0	0	51.23	11.79	11.77
154	LCA-8956-1	CTPB	81	14	5	5	5599	0	0	57.16	12.67	12.21
155	LCA-8956-1	CTPB	81	14	5	5	5599	0	0	59.02	12.32	12.35
156	LCA-8956-1	CTPB	81	14	5	5	5599	0	0	98.46	15.42	15.51
157	LCA-8956-1	CTPB	81	14	5	5	5599	0	0	140.72	19.41	19.46
158	LCA-8976-1	CTPB	81	14	5	5	1515	0	0	45.99	8.15	8.23
159	LCA-8976-1	CTPB	81	14	5	5	1515	0	0	50.40	8.46	8.47
160	LCA-8976-1	CTPB	81	14	5	5	1515	0	0	78.12	9.93	9.78
161	LCA-8976-1	CTPB	81	14	5	5	1515	0	0	105.01	11.10	11.1
162	LCA-8976-1	CTPB	81	14	5	5	1515	0	0	129.76	11.56	12.37
163	LCA-8976-1	CTPB	81	14	5	5	1515	0	0	155.48	11.94	13.67
164	LCA-8933-2	CTPB	80	14	5	5	2422	1	5.1	42.75	10.06	10.17
165	LCA-8933-2	CTPB	80	14	5	5	2422	1	5.1	59.02	11.51	11.72
166	LCA-8933-2	CTPB	80	14	5	5	2422	1	5.1	74.95	12.80	12.92
167	LCA-8933-2	CTPB	80	14	5	5	2422	1	5.1	83.63	13.56	13.54
168	LCA-8933-2	CTPB	80	14	5	5	2422	1	5.1	111.49	15.52	15.41
169	LCA-8934-1	CTPB	80	14	5	5	2787	1	9.2	57.85	13.18	13.53
170	LCA-8934-1	CTPB	80	14	5	5	2787	1	9.2	76.39	14.63	15.22
171	LCA-8934-1	CTPB	80	14	5	5	2787	1	9.2	89.36	15.57	16.29
172	LCA-8934-1	CTPB	80	14	5	5	2787	1	9.2	95.70	16.10	16.79
173	LCA-8934-1	CTPB	80	14	5	5	2787	1	9.2	105.63	17.22	17.54
174	LCA-8934-1	CTPB	80	14	5	5	2787	1	9.2	144.58	19.76	20.11
175	LCA-8935-1	CTPB	80	14	5	5	3163	1	5.1	69.50	14.99	14.74
176	LCA-8935-1	CTPB	80	14	5	5	3163	1	5.1	83.15	16.26	15.95
177	LCA-8935-1	CTPB	80	14	5	5	3163	1	5.1	106.18	18.36	17.83
178	LCA-8935-1	CTPB	80	14	5	5	3163	1	5.1	113.97	18.77	18.42
179	LCA-8935-1	CTPB	80	14	5	5	3163	1	5.1	118.66	18.97	18.76
180	LCA-8935-1	CTPB	80	14	5	5	3163	1	5.1	147.82	20.93	20.67

Supplementary Table S1. Training dataset used to train ANN model 1

S. No	Name	Binder	AP %	Binder %	Al %	Al size (um)	AP SSA (m <sup>2</sup> /gm)	Fe <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> SSA (m <sup>2</sup> /gm)	P, bar	r, mm/s	ANN r, mm/s
181	LCA-8936-1	CTPB	80	14	5	5	3634	1	9.2	53.57	14.61	15.29
182	LCA-8936-1	CTPB	80	14	5	5	3634	1	9.2	78.46	17.09	17.77
183	LCA-8936-1	CTPB	80	14	5	5	3634	1	9.2	89.08	17.96	18.67
184	LCA-8936-1	CTPB	80	14	5	5	3634	1	9.2	123.21	21.23	21.19
185	LCA-8936-1	CTPB	80	14	5	5	3634	1	9.2	131.62	21.77	21.72
186	LCA-8954-1	CTPB	80	14	5	5	5599	1	9.2	54.95	17.86	18.03
187	LCA-8954-1	CTPB	80	14	5	5	5599	1	9.2	57.64	18.72	18.4
188	LCA-8954-1	CTPB	80	14	5	5	5599	1	9.2	74.05	20.37	20.44
189	LCA-8954-1	CTPB	80	14	5	5	5599	1	9.2	75.70	20.40	20.63
190	LCA-8954-1	CTPB	80	14	5	5	5599	1	9.2	93.84	22.23	22.68
191	LCA-8954-1	CTPB	80	14	5	5	5599	1	9.2	105.90	23.37	23.94
192	LCA-8954-1	CTPB	80	14	5	5	5599	1	9.2	108.59	23.83	24.21
193	LCA-8955-1	CTPB	80	14	5	5	5599	1	5.1	22.41	10.13	10.19
194	LCA-8955-1	CTPB	80	14	5	5	5599	1	5.1	43.92	14.10	14.84
195	LCA-8955-1	CTPB	80	14	5	5	5599	1	5.1	47.09	14.73	15.31
196	LCA-8955-1	CTPB	80	14	5	5	5599	1	5.1	74.39	17.86	18.57
197	LCA-8955-1	CTPB	80	14	5	5	5599	1	5.1	79.36	19.23	19.11
198	LCA-8955-1	CTPB	80	14	5	5	5599	1	5.1	82.74	19.61	19.47
199	LCA-8955-1	CTPB	80	14	5	5	5599	1	5.1	107.56	22.17	22.01
200	LCA-8955-1	CTPB	80	14	5	5	5599	1	5.1	136.93	24.79	24.67
201	LCA-8967-1	CTPB	80.9	14	5	5	3196	0.1	26.4	13.86	6.15	6.75
202	LCA-8967-1	CTPB	80.9	14	5	5	3196	0.1	26.4	27.23	8.64	8.62
203	LCA-8967-1	CTPB	80.9	14	5	5	3196	0.1	26.4	33.03	9.19	9.34
204	LCA-8967-1	CTPB	80.9	14	5	5	3196	0.1	26.4	43.09	10.19	10.39
205	LCA-8967-1	CTPB	80.9	14	5	5	3196	0.1	26.4	47.16	10.72	10.78
206	LCA-8967-1	CTPB	80.9	14	5	5	3196	0.1	26.4	68.46	12.65	12.61
207	LCA-8967-1	CTPB	80.9	14	5	5	3196	0.1	26.4	134.17	17.65	18.15
208	LCA-8968-1	CTPB	80.9	14	5	5	3196	0.1	5.1	27.10	8.36	8.61
209	LCA-8968-1	CTPB	80.9	14	5	5	3196	0.1	5.1	36.13	9.47	9.83
210	LCA-8968-1	CTPB	80.9	14	5	5	3196	0.1	5.1	41.37	9.98	10.41
211	LCA-8968-1	CTPB	80.9	14	5	5	3196	0.1	5.1	45.37	10.31	10.82
212	LCA-8968-1	CTPB	80.9	14	5	5	3196	0.1	5.1	66.40	12.09	12.65
213	LCA-8968-1	CTPB	80.9	14	5	5	3196	0.1	5.1	69.98	12.42	12.94
214	LCA-8968-1	CTPB	80.9	14	5	5	3196	0.1	5.1	123.76	16.43	17.5
215	LCA-8969-1	CTPB	80.8	14	5	5	3359	0.2	10	16.82	7.42	7.63
216	LCA-8969-1	CTPB	80.8	14	5	5	3359	0.2	10	23.44	10.64	8.96
217	LCA-8969-1	CTPB	80.8	14	5	5	3359	0.2	10	31.58	9.96	10.44
218	LCA-8969-1	CTPB	80.8	14	5	5	3359	0.2	10	50.81	12.29	12.886
219	LCA-8969-1	CTPB	80.8	14	5	5	3359	0.2	10	56.67	12.80	13.47
220	LCA-8969-1	CTPB	80.8	14	5	5	3359	0.2	10	81.15	15.14	15.71

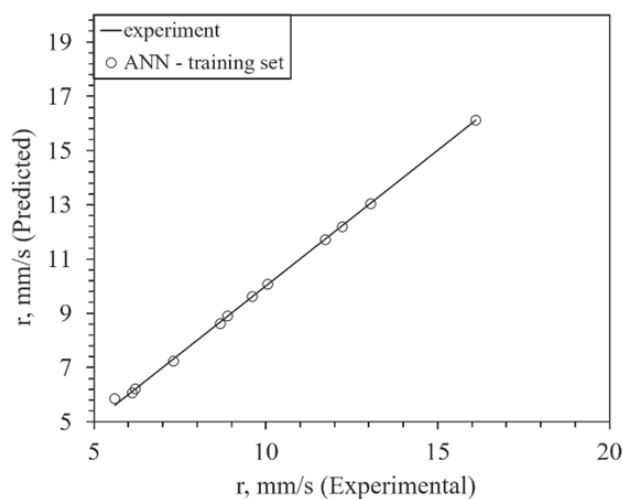
Supplementary Table S1. Training dataset used to train ANN model 1

S. No	Name	Binder	AP %	Binder %	Al %	Al size (um)	AP SSA (m <sup>2</sup> /gm)	Fe <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> SSA (m <sup>2</sup> /gm)	P, bar	r, mm/s	ANN r, mm/s
221	LCA-8969-1	CTPB	80.8	14	5	5	3359	0.2	10	157.13	21.01	21.67
222	LCA-8969X-2	CTPB	80.8	14	5	5	3359	0.2	8.4	13.93	6.73	6.95
223	LCA-8969X-2	CTPB	80.8	14	5	5	3359	0.2	8.4	25.86	11.15	9.19
224	LCA-8969X-2	CTPB	80.8	14	5	5	3359	0.2	8.4	33.09	10.26	10.41
225	LCA-8969X-2	CTPB	80.8	14	5	5	3359	0.2	8.4	53.57	12.57	12.82
226	LCA-8969X-2	CTPB	80.8	14	5	5	3359	0.2	8.4	59.23	13.16	13.36
227	LCA-8969X-2	CTPB	80.8	14	5	5	3359	0.2	8.4	84.05	15.75	15.58
228	LCA-8969X-2	CTPB	80.8	14	5	5	3359	0.2	8.4	164.72	21.95	21.87
229	LCA-8970-1	CTPB	80.4	14	5	5	2440	0.6	9.2	26.89	8.43	8.17
230	LCA-8970-1	CTPB	80.4	14	5	5	2440	0.6	9.2	36.61	9.55	9.57
231	LCA-8970-1	CTPB	80.4	14	5	5	2440	0.6	9.2	44.33	10.46	10.46
232	LCA-8970-1	CTPB	80.4	14	5	5	2440	0.6	9.2	53.78	11.25	11.37
233	LCA-8970-1	CTPB	80.4	14	5	5	2440	0.6	9.2	70.19	12.62	12.72
234	LCA-8970-1	CTPB	80.4	14	5	5	2440	0.6	9.2	73.64	12.93	12.98
235	LCA-8970-1	CTPB	80.4	14	5	5	2440	0.6	9.2	152.37	18.44	18.56
236	LCA-8981-1	CTPB	80.6	14	5	5	4715	0.4	3	12.41	6.27	6.93
237	LCA-8981-1	CTPB	80.6	14	5	5	4715	0.4	3	35.92	10.85	11.26
238	LCA-8981-1	CTPB	80.6	14	5	5	4715	0.4	3	38.96	11.46	11.66
239	LCA-8981-1	CTPB	80.6	14	5	5	4715	0.4	3	54.81	13.21	13.33
240	LCA-8981-1	CTPB	80.6	14	5	5	4715	0.4	3	62.54	13.82	14.02
241	LCA-8971-1	CTPB	80.7	14	5	5	2821	0.3	3.7	25.58	7.52	7.71
242	LCA-8971-1	CTPB	80.7	14	5	5	2821	0.3	3.7	29.85	8.13	8.28
243	LCA-8971-1	CTPB	80.7	14	5	5	2821	0.3	3.7	37.78	8.79	9.21
244	LCA-8971-1	CTPB	80.7	14	5	5	2821	0.3	3.7	40.47	9.14	9.48
245	LCA-8971-1	CTPB	80.7	14	5	5	2821	0.3	3.7	59.85	10.85	11.14
246	LCA-8971-1	CTPB	80.7	14	5	5	2821	0.3	3.7	60.95	10.92	11.22
247	LCA-8971-1	CTPB	80.7	14	5	5	2821	0.3	3.7	117.69	15.09	15.72
248	LCA-8973-1	CTPB	80.7	14	5	5	1520	0.3	5.1	22.27	6.32	6.7
249	LCA-8973-1	CTPB	80.7	14	5	5	1520	0.3	5.1	30.27	7.24	7.57
250	LCA-8973-1	CTPB	80.7	14	5	5	1520	0.3	5.1	33.44	7.62	7.89
251	LCA-8973-1	CTPB	80.7	14	5	5	1520	0.3	5.1	52.81	9.35	9.38
252	LCA-8973-1	CTPB	80.7	14	5	5	1520	0.3	5.1	100.46	12.65	11.95
253	LCA-8973-1	CTPB	80.7	14	5	5	1520	0.3	5.1	127.55	13.74	13.32
254	LCA-8977-1	CTPB	80.9	14	5	5	1317	0.1	26.4	30.61	7.32	7.7
255	LCA-8977-1	CTPB	80.9	14	5	5	1317	0.1	26.4	30.82	7.37	7.72
256	LCA-8977-1	CTPB	80.9	14	5	5	1317	0.1	26.4	34.89	7.72	8.06
257	LCA-8977-1	CTPB	80.9	14	5	5	1317	0.1	26.4	50.88	9.17	9.17
258	LCA-8977-1	CTPB	80.9	14	5	5	1317	0.1	26.4	94.11	11.84	11.51
259	LCA-8977-1	CTPB	80.9	14	5	5	1317	0.1	26.4	123.62	13.13	13.05

Supplementary Table S2. Validation dataset of ANN model 1

S. No	Name	Binder	AP %	Binder %	Al %	Al size (um)	AP SSA (m <sup>2</sup> /gm)	Fe <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> SSA (m <sup>2</sup> /gm)	P, bar	r, mm/s	ANN r, mm/s	% dev
1	LCA-8906-1	HTPB	77	12	10	15	3985	1	8.4	20.27	10.01	9.99	-0.17
2	LCA-8906-1	HTPB	77	12	10	15	3985	1	8.4	33.99	12.90	12.48	-3.27
3	LCA-8906-1	HTPB	77	12	10	15	3985	1	8.4	41.85	13.97	13.83	-1.00
4	LCA-8906-1	HTPB	77	12	10	15	3985	1	8.4	60.40	16.26	16.46	1.25
5	LCA-8906-1	HTPB	77	12	10	15	3985	1	8.4	65.91	17.30	17.09	-1.19
6	LCA-8906-1	HTPB	77	12	10	15	3985	1	8.4	98.32	19.89	20.1	1.06
7	LCA-8906-1	HTPB	77	12	10	15	3985	1	8.4	113.69	21.51	21.32	-0.90
8	LCA-8978-1	CTPB	80	14	5	5	1532	1	9.4	22.82	7.32	7.21	-1.43
9	LCA-8978-1	CTPB	80	14	5	5	1532	1	9.4	39.09	9.30	9.73	4.66
10	LCA-8978-1	CTPB	80	14	5	5	1532	1	9.4	44.26	9.88	10.32	4.44
11	LCA-8978-1	CTPB	80	14	5	5	1532	1	9.4	59.78	11.20	11.62	3.73
12	LCA-8978-1	CTPB	80	14	5	5	1532	1	9.4	61.85	11.38	11.76	3.34
13	LCA-8978-1	CTPB	80	14	5	5	1532	1	9.4	109.70	14.50	14.29	-1.47
14	LCA-8978-1	CTPB	80	14	5	5	1532	1	9.4	129.55	15.77	15.13	-4.07

## Appendix II



Supplementary Figure S2. Training set scatter graph of experimental r vs ANN predicted r for ANN model 2.

Supplementary Table S3. Training dataset used to train ANN model 2

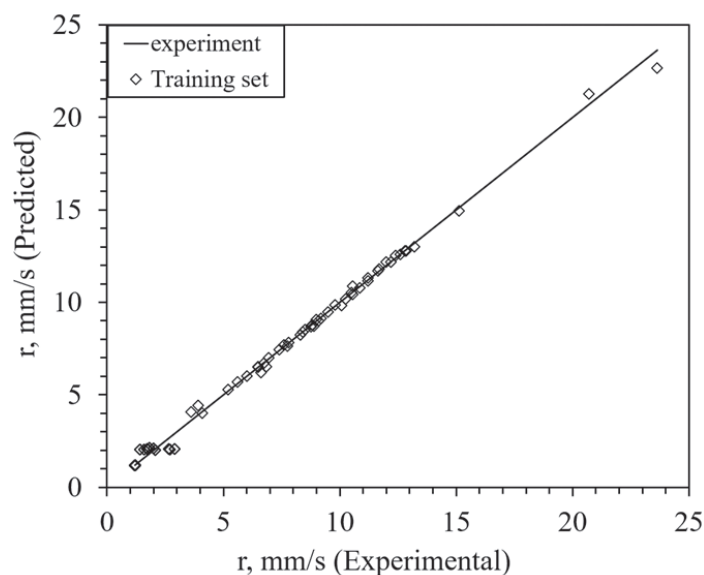
S. No	Propellant	Catalysts	Heat release J/g	Pressure (bar)	r (mm/s)	ANN r, mm/s	% dev
1	AP-HTPB	No	440	30	6.19	6.22	0.48
				50	7.31	7.25	-0.82
				70	8.881	8.9	0.21
2	AP-HTPB	MnOx-A	873	30	5.6	5.86	4.64
				50	8.67	8.62	-0.57
				70	11.72	11.73	0.08
3	AP-HTPB	MnOx-B	1438.2	30	6.1	6.07	-0.49
				50	9.6	9.62	0.21
				70	13.04	13.04	0
4	AP-HTPB	MnOx-E	1893.9	30	10.05	10.08	0.29
				50	16.11	16.12	0.06
5	AP-HTPB	Fe203	1757	30	12.22	12.19	-0.24



**Supplementary Table S4. Validation dataset used to test ANN model 2**

S. No	Propellant	Catalysts	Heat release in J/g	Pressure (bar)	r (mm/s)	ANN r, mm/s	% dev
1	AP-HTPB	MnOx-E	1893.9	70	21.22	20.75	-2.21
2	AP-HTPB	Fe2O3	1757	50	18.91	19.12	1.11
				70	21.74	21.3	-2.02

### Appendix III


**Supplementary Figure S3. Training set scatter graph of experimental r vs ANN predicted r for ANN model 3.**
**Supplementary Table S5. Training dataset used to train ANN model 3**

S. No	Name	AP %	Binder %	Al %	catalyst%	P, bar	Ea (KJ/mol)	catalyst	r, mm/s	ANN r, mm/s
1	FA-micro	80.8	17.6	1	0.6	40.00	132.70	u-Fe2O3	7.60	7.70
2	FA-micro	80.8	17.6	1	0.6	50.00	132.70	u-Fe2O3	8.40	8.41
3	FA-micro	80.8	17.6	1	0.6	60.00	132.70	u-Fe2O3	9.20	9.14
4	FA-micro	80.8	17.6	1	0.6	70.00	132.70	u-Fe2O3	9.80	9.86
5	FA-micro	80.8	17.6	1	0.6	80.00	132.70	u-Fe2O3	10.50	10.54
6	FA-micro	80.8	17.6	1	0.6	90.00	132.70	u-Fe2O3	11.20	11.17
7	FA-micro	80.8	17.6	1	0.6	100.00	132.70	u-Fe2O3	11.65	11.71
8	FA-micro	80.8	17.6	1	0.6	110.00	132.70	u-Fe2O3	12.20	12.19
9	FA-micro	80.8	17.6	1	0.6	120.00	132.70	u-Fe2O3	12.60	12.59
10	FB-nano	80.8	17.6	1	0.6	40.00	199.90	n-Fe2O3	9.50	9.49
11	FB-nano	80.8	17.6	1	0.6	50.00	199.90	n-Fe2O3	10.25	10.17
12	FB-nano	80.8	17.6	1	0.6	60.00	199.90	n-Fe2O3	10.85	10.79
13	FB-nano	80.8	17.6	1	0.6	70.00	199.90	n-Fe2O3	11.20	11.33
14	FB-nano	80.8	17.6	1	0.6	80.00	199.90	n-Fe2O3	11.70	11.80
15	FB-nano	80.8	17.6	1	0.6	90.00	199.90	n-Fe2O3	12.00	12.19
16	FB-nano	80.8	17.6	1	0.6	100.00	199.90	n-Fe2O3	12.40	12.52

**Supplementary Table S5. Training dataset used to train ANN model 3**

S. No	Name	AP %	Binder %	Al %	catalyst%	P, bar	Ea (KJ/mol)	catalyst	r, mm/s	ANN r, mm/s
17	FB-nano	80.8	17.6	1	0.6	110.00	199.90	n-Fe2O3	12.80	12.78
18	FB-nano	80.8	17.6	1	0.6	120.00	199.90	n-Fe2O3	13.20	12.99
19	FC	81.4	17.6	1	0	40.00	358.00	no	6.00	6.00
20	FC	81.4	17.6	1	0	50.00	358.00	no	6.50	6.52
21	FC	81.4	17.6	1	0	60.00	358.00	no	6.95	7.00
22	FC	81.4	17.6	1	0	70.00	358.00	no	7.40	7.44
23	FC	81.4	17.6	1	0	80.00	358.00	no	7.80	7.84
24	FC	81.4	17.6	1	0	100.00	358.00	no	8.50	8.51
25	FC	81.4	17.6	1	0	110.00	358.00	no	8.80	8.78
26	FC	81.4	17.6	1	0	120.00	358.00	no	9.10	9.01
27	CP-1	68.1	13.9	18	0	50.00	260.40	no	4.10	4.03
28	CP-2	68.1	13.9	18	0	70.00	260.40	no	5.20	5.29
29	CP-3	68.1	13.9	18	0	100.00	260.40	no	6.75	6.71
30	CP-2	67.1	13.9	18	1	50.00	210.40	G-TiO2	5.60	5.70
31	CP-4	67.1	13.9	18	1	100.00	210.40	G-TiO2	8.30	8.23
32	CP-3	67.1	13.9	18	1	50.00	196.20	TiO2	6.50	6.49
33	CP-4	67.1	13.9	18	1	70.00	196.20	TiO3	7.75	7.62
34	CP-5	67.1	13.9	18	1	100.00	196.20	TiO4	9.00	9.06
35	CP-CuO1	66	17	15	2	10.00	140.00	CuO	3.91	4.43
36	CP-CuO2	66	17	15	2	30.00	140.00	CuO	6.85	6.52
37	CP-CuO3	66	17	15	2	50.00	140.00	CuO	8.89	8.71
38	CP-CuO4	66	17	15	2	70.00	140.00	CuO	10.56	10.44
39	CP-CuO2	66	17	15	2	10.00	123.00	CuO	3.62	4.09
40	CP-CuO3	66	17	15	2	30.00	123.00	CuO	6.62	6.22
41	CP-CuO4	66	17	15	2	50.00	123.00	CuO	8.77	8.69
42	CP-CuO5	66	17	15	2	70.00	123.00	CuO	10.55	10.86
43	CP-CuO6	66	17	15	2	100.00	123.00	CuO	12.84	12.77
44	CP-CuO-n	66	17	15	2	10.00	77.20	n-CuO	10.08	9.84
45	CP-CuO-n	66	17	15	2	30.00	77.20	n-CuO	15.13	14.93
46	CP-CuO-n	66	17	15	2	70.00	77.20	n-CuO	20.71	21.26
47	CP-CuO-n	66	17	15	2	100.00	77.20	n-CuO	23.63	22.65
48	CP-CuO	74	25	0	1	1.01	27.00	n-CuO green syn	2.64	2.09
49	CP	75	25	0	0	1.01	41.00	no	1.22	1.19
50	CP	75	25	0	0	1.01	20.30	no	1.22	1.20
51	CP-NiCo	74	25	0	1	1.01	16.50	Ni-Co	2.08	2.02
52	CP-NiCu	74	25	0	1	1.01	17.70	Ni-Cu	1.77	2.03
53	CP-NiZn	74	25	0	1	1.01	18.40	Ni-Zn	1.59	2.03
54	CP	75	25	0	0	1.01	37.73	no	1.19	1.19

Supplementary Table S5. Training dataset used to train ANN model 3

S. No	Name	AP %	Binder %	Al %	catalyst%	P, bar	Ea (KJ/mol)	catalyst	r, mm/s	ANN r, mm/s
55	CP-CeO2	74	25	0	1	1.01	27.83	CeO2	2.00	2.10
56	CP-Nd2O3	74	25	0	1	1.01	21.43	Nd2O3	1.42	2.05
57	CP-Pr2O3	74	25	0	1	1.01	26.65	Pr2O3	1.71	2.09
58	CP	75	25	0	0	1.01	37.73	no	1.19	1.19
59	CP-FeC2O4	74	25	0	1	1.01	21.43	FeC2O4	2.70	2.05
60	CP-NiC2O4	74	25	0	1	1.01	31.30	NiC2O4	1.81	2.13
61	CP-CoC2O4	74	25	0	1	1.01	26.56	CoC2O4	2.90	2.09
62	CP-CuO	74	25	0	1	1.01	27.00	n-CuO green syn	2.64	2.09
63	CP	75	25	0	0	1.01	41.00	no	1.22	1.19
64	CP	75	25	0	0	1.01	20.30	no	1.22	1.20
65	CP-NiCo	74	25	0	1	1.01	16.50	Ni-Co	2.08	2.02
66	CP-NiCu	74	25	0	1	1.01	17.70	Ni-Cu	1.77	2.03
67	CP-NiZn	74	25	0	1	1.01	18.40	Ni-Zn	1.59	2.03
68	CP	75	25	0	0	1.01	37.73	no	1.19	1.19
69	CP-CeO2	74	25	0	1	1.01	27.83	CeO2	2.00	2.10
70	CP-Nd2O3	74	25	0	1	1.01	21.43	Nd2O3	1.42	2.05
71	CP-Pr2O3	74	25	0	1	1.01	26.65	Pr2O3	1.71	2.09
72	CP	75	25	0	0	1.01	37.73	no	1.19	1.19
73	CP-FeC2O4	74	25	0	1	1.01	21.43	FeC2O4	2.70	2.05
74	CP-NiC2O4	74	25	0	1	1.01	31.30	NiC2O4	1.81	2.13
75	CP-CoC2O4	74	25	0	1	1.01	26.56	CoC2O4	2.90	2.09
76	CP-CuO	74	25	0	1	1.01	27.00	n-CuO green syn	2.64	2.09
77	CP	75	25	0	0	1.01	41.00	no	1.22	1.19
78	CP	75	25	0	0	1.01	20.30	no	1.22	1.20
79	CP-NiCo	74	25	0	1	1.01	16.50	Ni-Co	2.08	2.02
80	CP-NiCu	74	25	0	1	1.01	17.70	Ni-Cu	1.77	2.03
81	CP-NiZn	74	25	0	1	1.01	18.40	Ni-Zn	1.59	2.03
82	CP	75	25	0	0	1.01	37.73	no	1.19	1.19
83	CP-CeO2	74	25	0	1	1.01	27.83	CeO2	2.00	2.10
84	CP-Nd2O3	74	25	0	1	1.01	21.43	Nd2O3	1.42	2.05
85	CP-Pr2O3	74	25	0	1	1.01	26.65	Pr2O3	1.71	2.09
86	CP	75	25	0	0	1.01	37.73	no	1.19	1.19
87	CP-FeC2O4	74	25	0	1	1.01	21.43	FeC2O4	2.70	2.05
88	CP-NiC2O4	74	25	0	1	1.01	31.30	NiC2O4	1.81	2.13
89	CP-CoC2O4	74	25	0	1	1.01	26.56	CoC2O4	2.90	2.09
90	CP-CuO	74	25	0	1	1.01	27.00	n-CuO green syn	2.64	2.09
91	CP	75	25	0	0	1.01	41.00	no	1.22	1.19
92	CP	75	25	0	0	1.01	20.30	no	1.22	1.21

**Supplementary Table S5. Training dataset used to train ANN model 3**

S. No	Name	AP %	Binder %	Al %	catalyst%	P, bar	Ea (KJ/mol)	catalyst	r, mm/s	ANN r, mm/s
93	CP-NiCo	74	25	0	1	1.01	16.50	Ni-Co	2.08	2.02
94	CP-NiCu	74	25	0	1	1.01	17.70	Ni-Cu	1.77	2.03
95	CP-NiZn	74	25	0	1	1.01	18.40	Ni-Zn	1.59	2.03
96	CP	75	25	0	0	1.01	37.73	no	1.19	1.19
97	CP-CeO2	74	25	0	1	1.01	27.83	CeO2	2.00	2.10
98	CP-Nd2O3	74	25	0	1	1.01	21.43	Nd2O3	1.42	2.05
99	CP-Pr2O3	74	25	0	1	1.01	26.65	Pr2O3	1.71	2.09
100	CP	75	25	0	0	1.01	37.73	no	1.19	1.19
101	CP-FeC2O4	74	25	0	1	1.01	21.43	FeC2O4	2.70	2.05
102	CP-NiC2O4	74	25	0	1	1.01	31.30	NiC2O4	1.81	2.13
103	CP-CoC2O4	74	25	0	1	1.01	26.56	CoC2O4	2.90	2.09

**Supplementary Table S6. Validation dataset of ANN model 3**

S. No	Name	AP %	Binder %	Al %	catalyst%	P, bar	Ea (KJ/mol)	catalyst	r, mm/s	ANN r, mm/s	% dev
1	FC	81.4	17.6	1	0	90.00	358.00	no	8.20	8.19	-0.12
2	CP-CuO5	66	17	15	2	100.00	140.00	CuO	12.67	11.62	-8.28
3	CP-CuO-n	66	17	15	2	50.00	77.20	n-CuO	18.28	18.99	3.88
4	CP-3	67.1	13.9	18	1	70.00	210.40	G-TiO2	6.75	6.80	0.74