Electronic Supplementary Information

Mass production of aluminum and aluminum oxide nanoparticles by electrical explosion of wire

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Table S1. *Effective factors on preparation of AlNPs by EEE method.*

Factor	Name	Low Level	High Level
A	Wire diameter (mm)	0.10	0.50
B	Feed rate (cm/s)	1.00	4.00
C	Voltage (kV)	5.00	12.00
D	Carrier gas pressure (bar)	0.50	1.00
E	Pulse time (sec)	1.00	4.00
F	Fan pressure (%)	25.00	100.00
G	Electrode distance (cm)	1.00	5.00

Table S2. *Factors, levels and experimental results under standard Taguchi L_8 matrix.*

Run	A	B	C	D	E	F	G	Size(nm)
1	0.10	1.00	5.00	0.50	1.00	25.00	1.00	10.09
2	0.50	1.00	12.00	0.50	4.00	25.00	5.00	68.39
3	0.50	4.00	5.00	1.00	1.00	25.00	5.00	87.33
4	0.50	1.00	12.00	1.00	1.00	100.00	1.00	25.51
5	0.10	4.00	12.00	1.00	4.00	25.00	1.00	32.41
6	0.50	4.00	5.00	0.50	4.00	100.00	1.00	91.16
7	0.10	1.00	5.00	1.00	4.00	100.00	5.00	47.58
8	0.10	4.00	12.00	0.50	1.00	100.00	5.00	36.57

Table S3. *ANOVA results for factors by Taguchi model.*

Source	Sum of squares	dF	Mean square	F value	P-value (Prob>F)	Contribution %
Model	6090.75	5	1218.15	104.91	0.0095	-
A	2655.02	1	2655.02	228.65	0.0043	43.43
B	1149.60	1	1149.60	99.01	0.0099	18.80
C	671.24	1	671.24	57.81	0.0169	10.98
E	800.80	1	800.80	68.97	0.0142	13.10
G	814.06	1	814.06	70.11	0.0140	13.31
Pure Error	23.22	2	11.61			
Cor Total	6113.95	7				

***Table S4**. Experimental range and levels of the independent factors based on ultimate design by RSM method.*

Factors	Unit	Range and levels		
		+α	0	-α
Wire diameter (A)	mm	0.1	0.3	0.5
Feed rate (B)	cm/s	1	2.5	4
Electrode distance (C)	cm	1	3	5
Pulse time (D)	s	1	2	4
Voltage (E)	kV	5	8.5	12

***Table S5.** Experimental conditions and synthesized particles size by EEW used in ultimate design.*

Run	Factors					Response
No.	A	B	C	D	E	Particle size (nm)
1	0.5	4	5	4	12	149.85
2	0.1	1	5	4	12	80.56
3	0.1	2.5	3	2	8.5	99.75
4	0.1	2.5	3	4	12	76.48
5	0.1	1	1	1	12	9.66
6	0.1	2.5	1	1	5	101.90
7	0.1	1	1	4	12	33.84
8	0.1	1	3	2	12	42.96
9	0.5	4	5	4	12	143.90
10	0.3	2.5	3	4	5	145.22
11	0.3	2.5	5	1	5	142.07
12	0.3	2.5	1	1	5	110.64
13	0.5	1	1	2	8.5	75.66
14	0.5	4	5	4	8.5	154.57
15	0.3	1	1	2	5	106.35
16	0.5	4	3	4	12	115.96
17	0.3	1	1	1	5	89.79
18	0.3	2.5	1	4	12	61.80
19	0.3	4	5	2	5	156.47
20	0.5	4	3	2	12	100.97
21	0.3	2.5	3	2	8.5	14.28
22	0.3	4	1	1	8.5	91.68
23	0.5	4	1	1	8.5	101.85
24	0.1	1	3	1	5	105.74
25	0.5	4	5	1	5	150.44
26	0.3	2.5	3	2	8.5	110.18
27	0.1	1	5	4	8.5	119.85
28	0.5	4	5	2	5	165.42
29	0.5	1	5	4	8.5	137.58
30	0.5	2.5	3	1	12	64.28

Table S6. *ANOVA results for Response Surface Linear model*[a]

Source	Sum of squares	dF	Mean square	F value	P-value (Prob>F)
Model	41246.74	5	8249.35	104.26	< 0.0001
A	1164.98	1	1164.98	14.72	0.0008
B	2779.28	1	2779.28	35.13	< 0.0001
C	4839.55	1	4839.55	61.16	< 0.0001
D	2530.01	1	2530.01	31.97	< 0.0001
E	14146.42	1	14146.42	178.79	< 0.0001
Residual	1899.00	24	79.12		
Lack of fit	1880.71	22	85.49		0.1010
Pure error	18.29	2	9.15		
Cor Total	43145.74	29			

[a] R-squared = 0.9560, adjusted R-squared = 0.9468, adequate precision = 39.455, Predicted R-squared= 0.9324, Coefficient of Variation (C.V.) = 8.46. Predicted error sum of squares (press) = 2916.12