Supplementary materials

The adequacy of the aforementioned mathematical models is verified using the analysis of variance (ANOVA) method and the experiment next. Tables S1, S2, and S3 show the ANOVA results of the developed models for the machined depth, width and Ra, respectively.

As shown in Table S1, S2, S3, the value of F in the models of machined depth, machined width, machined Ra are 592.37, 89.1, 25.02, respectively. This indicates that the models are extremely significant with a probability of less than 0.01%. Meanwhile, the value of Prob>F is less than 0.05, indicating that the model terms are significant. Accordingly, as the same reason, A, B, AB, AC, BC, A^2, B^2, C^2, ABC, A^2B, A^2 and A^3 are significant model terms for the machined width. The values of R^2 and Adj. R^2 in Table S1, S2, S3 are 0.9994, 0.9960, 0.9859 and 0.9977, 0.9848, 0.9465, which are very close to 1. The ratios of signal to noise, which are the values of Adeq.Precision in this study (see Table S1, S2, S3), are normally greater than 4 [38-39]. Therefore, the values in all the cases indicate they are an adequate signal. Thus the mathematical models are adequate to predict the Ra of the surfaces and the machined depth, width of the micro-dimples over the range of parameters investigated in this study.

Table S1 ANOVA for the machined depth model.

Source	SS	d_f	MS	F	p-value Prob.>F	
Model	207.92	14	14.85	592.37	<0.0001	significant
A	1.95	1	1.95	77.92	0.0003	
B	4.88	1	4.88	194.63	<0.0001	
C	9.841×10^{-3}	1	9.841×10^{-3}	0.39	0.558	
AB	6.64	1	6.64	264.96	<0.0001	

AC	1.95	1	1.95	77.79	0.0003	
BC	8.44	1	8.44	336.55	<0.0001	
A^2	0.61	1	0.61	24.17	0.0044	
B^2	4.61	1	4.61	183.80	<0.0001	
C^2	0.42	1	0.42	16.69	0.0095	
ABC	9.34	1	9.34	372.52	<0.0001	
A^2B	4.36	1	4.36	174.10	<0.0001	
A^2C	1.58	1	1.58	62.86	0.0005	
AB^2	0.030	1	0.030	1.19	0.3260	
A^3	0.54	1	0.54	21.63	0.0056	
Pure.Error	0.13	5	0.025			
Cor.Total	208.05	19				
R^2	0.9994		Adj. R^2	0.9977		
Pred. R^2	N/A		Adeq.Precision	89.909		

Table S2 ANOVA for the machined width model.

Source	SS	d_f	MS	F	p-value Prob.>F	
Model	331.07	14	23.65	89.10	<0.0001	significant
A	0.50	1	0.50	1.88	0.2287	
B	0.086	1	0.086	0.32	0.5934	
C	2.27	1	2.27	8.54	0.0329	
AB	28.45	1	28.45	107.21	0.0001	
AC	31.43	1	31.43	118.43	0.0001	

BC	27.32	1	27.32	102.93	0.0002	
A^2	8.01	1	8.01	30.17	0.0027	
B^2	0.20	1	0.20	0.77	0.4198	
$C2$	0.91	1	0.91	3.44	0.1226	
ABC	10.37	1	10.37	39.08	0.0015	
A^2B	0.17	1	0.17	0.65	0.4579	
A^2C	1.497×10^{-3}	1	1.497×10^{-3}	5.641×10^{-3}	0.9430	
AB^2	4.43	1	4.43	16.70	0.0095	
A^3	3.00	1	3.00	11.29	0.0201	
Pure.Error	1.33	5	0.27			
Cor.Total	332.39	19				
R^2	0.9960		Adj. R^2	0.9848		
Pred. R^2	N/A		Adeq.Precision	52.58		

Table S3 ANOVA for the machined *Ra* model.

Source	SS	d_f	MS	F	p-value Prob.>F	
Model	2.81	14	2.81	25.02	0.0011	significant
A	0.044	1	0.044	5.44	0.0669	
B	0.20	1	0.20	24.62	0.0042	
C	0.013	1	0.013	1.63	0.2579	
AB	0.042	1	0.042	5.18	0.0719	
AC	1.770×10^{-3}	1	1.770×10^{-3}	0.22	0.6586	
BC	0.030	1	0.030	3.69	0.1128	

A^2	0.22	1	0.22	27.68	0.0033
B^2	0.27	1	0.27	33.74	0.0021
C^2	0.018	1	0.018	2.28	0.1915
ABC	0.048	1	0.048	5.92	0.0591
A^2B	5.831×10^{-3}	1	5.831×10^{-3}	0.73	0.4332
A^2C	2.292×10^{-3}	1	2.292×10^{-3}	0.29	0.6162
AB^2	0.11	1	0.11	14.12	0.0132
A^3	0.092	1	0.092	11.49	0.0195
Pure.Error	0.040	5	8.036×10^{-3}		
Cor.Total	2.85	19			
R^2	0.9859		Adj.R^2	0.9465	
Pred. R^2	N/A		Adeq.Precision	16.281	

The verified experiments are also carried out using the optimal parameters obtained by the software. The depth of the micro-dimples is desired to be 3-5 μm, the width is desired to be larger, and the surface quality is desired to be better. The multi-objective optimization results for laser power, number of passes, and scanning speed (*i.e.*, factors) are 13.11 W, 309 times and 13.87 mm/s, respectively. According to the designed models, the predicted values of the depth, width, and *Ra* are 4.475 μm, 53.893 μm, and 1.417 μm, respectively. And the observed depth, width, and the *Ra* of the structures are about 4.694 μm, 52.310 μm, and 1.471 μm (see Fig. S1), respectively, with an error of 4.90%, 2.94%, and 3.83%, respectively. The error percentages are within acceptable range (<8%), thus the developed models can predict the responses. The WCA and OCA of the surface are 146.7° and 134.8°, respectively, indicating excellent superamphiphobic characteristics.

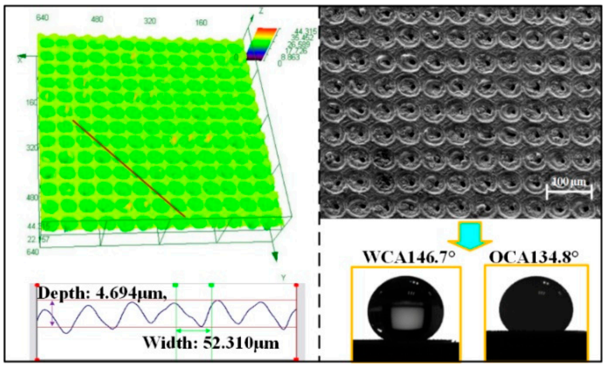

Fig. S1 Micro-dimples fabricated with the optimal process parameters using ULLM method.

The zone to measure the Ra values on sample surface are chosen by randomly selecting at least 15 continuous micro dimples both in perpendicular and parallel directions, and totally 5 different zones were chosen. All the measuring lines are set to connect the center of the dimples. The schematic illustration could be found in supplementary materials. The averaging value is used as the final Ra value.

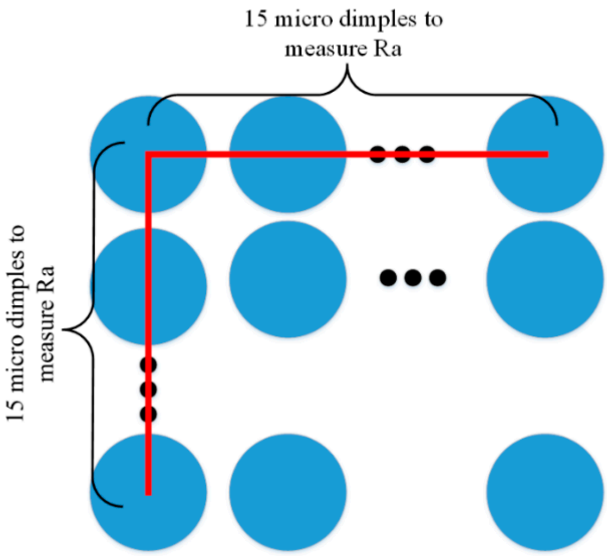

Fig. S2 Schematics of Ra measurement method.