Supplementary Information

Ingenious Replica Templated from Light Trapping Structure in Butterfly Wing Scales

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The fabrication method used in this manuscript is similar to what has been described in details by Xu et al. in Ref. [1]. Some slight modifications on the concentration of the precursor, the early treating methods of bio-templates (butterfly wings), the time and temperature of final selected-etching process were provided in details as follows. These modifications ensure that the final obtained inverse sample preserve well the functional ultrastructure of the original butterfly wings.

1) Pre-treatment of butterfly wings: the natural butterfly wings were rinsed three times with 0.65% NaCl solution followed by dipping them into a solution of aether for 10 minutes under ambient conditions. After that, the specimens were washed thoroughly by deionized water and dried in air for 12 hours. Then, the specimens were subjected to a series of dehydration pretreatment in 40%, 60%, 80%, 95% and pure ethanol with duration time of 10 minutes for each phase and also washed thoroughly by deionized water and then dried in air for 12 hours.
2) Area of the bio-template: in this manuscript, slices of butterfly wings, sandwiched between two glass slides, was 1cm×2cm. If the area of the bio-template is too big, precursor can't impregnate into the template. If the area of the bio-template is too small, the structures in scales are easily damaged by the press of the glass slides.
3) The amount of the impregnated precursor: in this manuscript, a volume of 5~8μl of the silica precursor was added to the edge of the assembly. This amount of the impregnated precursor ensures all the interspace of the light trapping structures will be filled completely.
4) The temperatures and times: the entire assembly was heated at 130℃ for 25 minutes to evaporate residual solvent After that, the whole assembly was dipped into a mixture of concentrated nitric acid and perchloric acid (1:1 in volume) while heating at 120℃ for 30 minutes.
5) At last, the whole assembly was washed by ultrasonic oscillation for 10~20minutes with deionized water. This process ensures that all the residues of the bio-template will be completely removed.

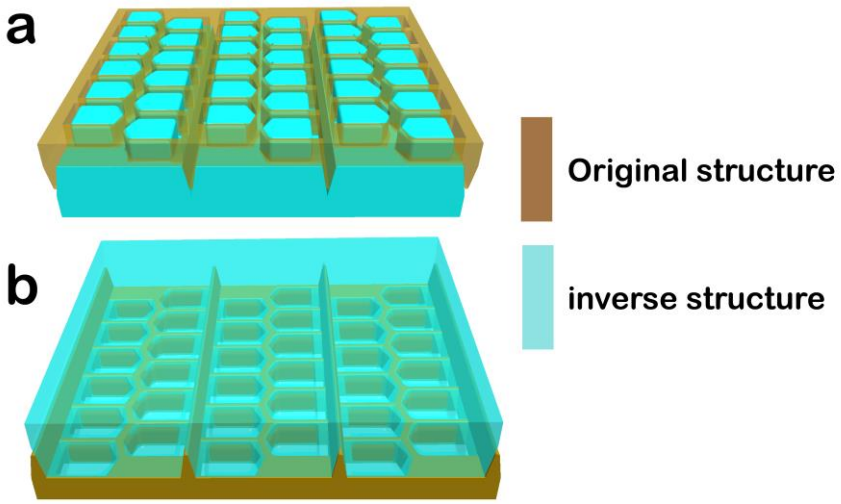

Fig. S1 Corresponding relationship between the original structure and the inverse structure. (a and b) Observation from different angles of this relationship.

References

1 Z. Xu, K. Yu, B. Li, R. Huang, P. Wu, H. B. Mao, N. Liao and Z. Q. Zhu, Optical properties of SiO_2 and ZnO nanostructured replicas of butterfly wing scales, *Nano Res.*, 2011, **4(8)**, 737-745.