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Supplementary Information

FDTD Modeling of Photonic Crystal Incorporated Gold Nanoparticles for Enhancing Localized Electric Field

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1. Programming code for obtaining the $|E|_{max}$

```
E2=getelectric("E-Field-467nm");
                          # Gets raw |E|^2 data matrix from monitor
MaxE2=max(E2);            # get the max E^2 from the matrix
MaxE=sqrt(MaxE2);              # caculate the square root of E^2 to get the max |E|
?MaxE;                    #print the value of |E|max
```

There are four steps to get the value of $|E|_{max}$ in each model:

a. Obtain the raw $|E|^2$ matrix from monitor at 467 nm
b. Use max() function to get the maximum value of E^2 in the matrix
c. Calculate the square root of E^2_{max}
d. Output $|E|_{max}$

2. Experimental

All the simulations were performed using a FDTD method, which is one of the most commonly used techniques for solving the scattering problem of periodic dielectric structures. A plane wave was used as the light source throughout this research. The boundary conditions were periodic boundary condition (PBC) in horizontal direction and perfectly matched layer (PML) in vertical direction. Thickness of each layer was 100 nm, distance between adjacent layers was also 100 nm, horizontal length of the top layer was 300 nm and length increment from top layer to under layer was 100 nm. The refractive index of the model was 1.56+0.06i, equivalent to chitin, which is the main composition of butterfly wing.[1, 2] The mesh size was chosen to obtain a good tradeoff between the computer memory required and the simulation time, while ensuring convergence of the results. $|E|_{max}$ were obtained by programed codes (see Supplementary Information). A convergence test was carefully performed.

Notes and references

1. Y. Tan, J. Gu, X. Zang, W. Xu, K. Shi, L. Xu and D. Zhang, *Angewandte Chemie*, 2011, **50**, 8307-8311.
2. Y. Tan, J. Gu, L. Xu, X. Zang, D. Liu, W. Zhang, Q. Liu, S. Zhu, H. Su, C. Feng, G. Fan and D. Zhang, *Advanced Functional Materials*, 2012, **22**, 1578-1585.