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ARTICLE (Supporting information)

Manipulating the distribution of electric field intensity to effectively enhance the spatial and spectral fluorescence intensity of fluorescent nanodiamonds

Shan-Jen Kuo[a], Pei-Chang Tsai[b], Yang-Chun Lee[a], Sih-Wei Chang[a], Shingo Sotoma[b], Chia-Yi Fang[b], Huan-Cheng Chang[b,c,d], and Hsuen-Li Chen[a,e,*]

1) Additional discussions about the enhanced effect of Al/SiO_2 nanocavity system for the fluorescence intensity of FNDs.

Thank you very much for your precious comments.

According to our previous study [1], the relationship between the optical admittance and the amplitude of surface electric-field ($E_{surface}$) can be obtained through the transfer matrix method.[1] The following equation S1 can express the surface electrical field ($E_{surface}$) on the of nanocavity:

$$E_{surface} = \sqrt{\frac{4}{(\alpha+1)^2+\beta^2}} \qquad \text{(S1)}$$

where α and β are the real and imaginary parts of the optical admittance of the thin-film assembly. Therefore, the maximum $E_{surface}$ could be up to 2 when both α and β approached zero. In our previous study, through well controlled the thickness of the dielectric SiO_2 film, the maximum $E_{surface}$ on the surface of two dimensional (2D) materials can be enhanced.[2]

In this study, we used the concept to design an Al/SiO_2 nanocavity and systematic interrogated the $E_{surface}$ effect of the nanocavity for the FNDs by both thin-film interference and 3D-FDTD methods. The spherical shape of FNDs unlike 2D materials, the $E_{surface}$ would perform a non-uniform distribution inside the FND. Moreover, due to the surface of the FND generally lacked NV^- centers, we should control and manipulate the distributions of the electric-field intensities within FNDs by tuning the thickness of the capping SiO_2 layer of the Al/SiO_2 nanocavities to effectively enhance the fluorescence intensity of the FNDs.

Note and References:

[a]*Department of Materials Science and Engineering, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, Taipei, 10617 Taiwan*

[b]*Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei 106, Taiwan*

[c]*Department of Chemical Engineering, National Taiwan University of Science and Technology, Taipei 106, Taiwan*

[d]*Department of Chemistry, National Taiwan Normal University, Taipei 106, Taiwan*

[e]*Center of Atomic Initiative for New Materials (AI-MAT), National Taiwan University, Taiwan*

1. *Y.-C. Lee, E.-Y. Wang, Y.-L. Liu, H.-L. Chen, Chem. Mater. 2015,* ***27****, 876–884*
2. *Y.-C. Lee, Y.-C. Tseng, H.-L. Chen, ACS Photonics, 2017,* ***4****, 93–105*

