

Fluorescent Nanodiamond: A Versatile Material for Optical Bioimaging

Huan-Cheng Chang

Institute of Atomic and Molecular Sciences, Academia Sinica, Taiwan

Diamond has received increasing attention for promising biomedical applications. The material is biocompatible, non-toxic, and can be easily conjugated with bioactive molecules such as proteins and DNA. Recently, nanoscale diamond particles have been applied as fluorescent biolabels and therapeutic agents. The fluorescence, arising from photoexcitation of negatively charged nitrogen-vacancy (NV^-) defect centers, can be substantially enhanced when type Ib diamond nanocrystallites are bombarded by a high-energy particle beam, subsequently annealed at high temperatures, and finally oxidized in air. The center absorbs light strongly at 560 nm, fluoresces efficiently at 690 nm, and is exceptionally photostable (without photoblinking and photobleaching). It is an ideal candidate for super-resolution imaging with stimulated emission depletion (STED) microscopy and long-term cell labeling, tracking, and sorting with flow cytometry. This lecture summarizes recent advances in the development of fluorescent nanodiamonds (FNDs) for optical bioimaging and biolabeling with single particle sensitivity, long-term tracking capability, and nanometric resolution and precision in cells as well as whole organisms such as *C. elegans*, zebrafishes, and mice.

References:

1. S.-J. Yu, M.-W. Kang, H.-C. Chang, K.-M. Chen, and Y.-C. Yu, *J. Am. Chem. Soc.* **127**, 17604-17605 (2005).
2. C.-C. Fu, H.-Y. Lee, K. Chen, T.-S. Lim, H.-Y. Wu, P.-K. Lin, P.-K. Wei, P.-H. Tsao, H.-C. Chang, and W. Fann, *Proc. Natl. Acad. Sci. USA* **104**, 727-732 (2007).
3. Y.-R. Chang, H.-Y. Lee, K. Chen, C.-C. Chang, D.-S. Tsai, C.-C. Fu, T.-S. Lim, Y.-K. Tzeng, C.-Y. Fang, C.-C. Han, H.-C. Chang, and W. Fann, *Nature Nanotech.* **3**, 284-288 (2008).
4. N. Mohan, C.-S. Chen, H.-H. Hsieh, Y.-C. Wu, and H.-C. Chang, *Nano Lett.* **10**, 3692-3699 (2010).
5. Y.-K. Tzeng, O. Faklaris, B.-M. Chang, Y. Kuo, J.-H. Hsu, and H.-C. Chang, *Angew. Chem. Int. Ed.* **50**, 2262-2265 (2011).
6. C.-Y. Fang, V. Vaijyanthimala, C.-A. Cheng, S.-H. Yeh, C.-F. Chang, C.-L. Li, and H.-C. Chang, *Small* **7**, 3363-3370 (2011).