THE HONG KONG POLYTECHNIC UNIVERSITY
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Development of a New Generation of Fluorescent Labeling Agents Based on Rare-earth Doped Phosphors

Biological Imaging

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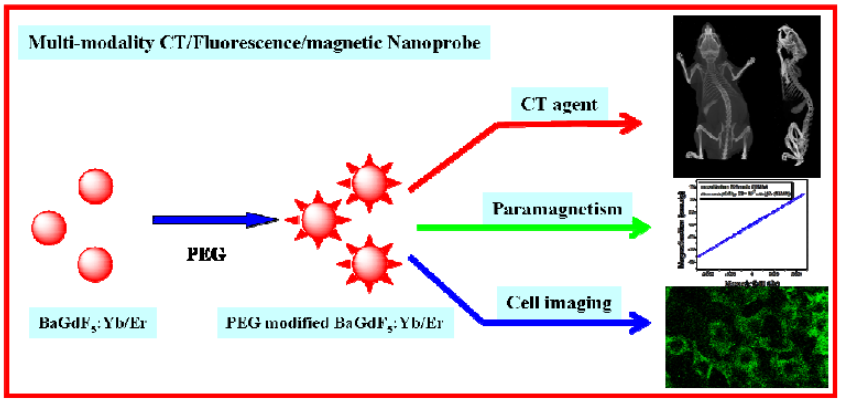
. Biolabel, Biosensor, and Medical Contrast Agents in Lab Research and Clinical Applications .

Fluorescent labeling techniques have been widely used in biological research and clinical diagnosis. Current commercial fluorescent labeling agents encounter several challenges. The traditional labeling agents such as organic dyes are not photostable. Commercial quantum dots are still controversial due to their inherent toxicity and blinking effect. This project has developed a new generation of labeling agents based on rare-earth doped inorganic phosphors for bio-imaging applications. A novel, one-pot reaction, environmentally-friendly and facile synthesis technique, through which water-soluble and biocompatible phosphors with some functional groups on their surface has been developed. Compared to those commercial labeling agents, the new labeling agents are more attractive for both in vitro and in vivo imaging due to their long lifetimes, superior photostability and low toxicity. In particular, near-infrared labeling agent based on up-conversion luminescence has been demonstrated, which is of great benefit to deeper tissue penetration and reduced autofluorescence. Additionally, multifunctional characteristics, such as magnetic properties intrinsically exhibited in the phosphors, facilitate the utilization of this new type of labeling agents in various applications. Importantly, we have found that multi-modal bioimaging of upconversion fluorescence, magnetic resonance imaging (MRI), X-ray imaging, and computed X-ray tomography (CT) can be achieved using a single phase of nanoscale bioprobe. The application of our multimodal nanoprobes is particularly important for developing a new generation of cost-effective, faster and more accurate diagnostic technologies.



Representative Publications

1. S. J. Zeng, M.-K. Tsang, C.-F. Chan, K.-L. Wong, and J. H. Hao*, "PEG modified $BaGdF_5$: Yb/Er nanoprobes for multi-modal upconversion fluorescent, in vivo X-ray computed tomography and biomagnetic imaging", *Biomaterials* 33, 9232 (2012).
2. Z.-L. Wang, J. H. Hao*, H. L. W. Chan, W.-T. Wong, and K.-L. Wong, "A strategy to simultaneously realizing the cubic-to-hexagonal phase transition and controlling small size of $NaYF_4$: Yb^{3+}, Er^{3+} nanocrystals for in-vitro cell imaging", *Small* 8, 1863 (2012).
3. S. J. Zeng, M.-K. Tsang, C.-F. Chan, K.-L. Wong, B. Fei, and J. H. Hao*, "Dual-modal fluorescent/magnetic bioprobes based on small sized upconversion nanoparticles of amine-functionalized $BaGdF_5$:Yb/Er", *Nanoscale* **4, 5118 (2012).**
4. Z.-L. Wang, J. H. Hao*, H. L. W. Chan, G.-L. Law, W.-T. Wong, K.-L. Wong, M. B. Murphy, T. Su, Z. H. Zhang, and S. Q. Zeng, "Simultaneous synthesis and functionalization of water-soluble up-conversion nanoparticles for in-vitro cell and nude mouse imaging", *Nanoscale* 3, 2175 (2011).

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