

PDF - INTRODUCTION: BIO AND NANO IMAGING AND ANALYSIS - researchcub.info

Research focusing on the intersection of life sciences and nanotechnology is producing new fields such as nanobiotechnology, nanobiology and nanomedicine. This interaction is occurring in both directions. On one hand, biological molecules can be used to synthesize and organize inorganic functional nanomaterials into well-defined structures (Ma and others, 2008; Sotiropoulou and others, 2008; van Bommel and others, 2003). On the other hand, nanomaterials can be used to study biology and develop biomedicines. For example, labeled nanomaterials can serve as effective long-lasting dyes for bio-imaging (Lee and others, 2007; Medintz and others, 2005; Xie and others, 2011) and nanomaterials are ideal drug-carriers for the development of new drug systems (Dobson, 2006; Nakanishi and others, 2009; Portney and Ozkan, 2006). Microscopy is a powerful tool that can image nanostructures, track nanomaterials in bio-systems, measure physical properties, determine compositions, and even create and manipulate nanostructures. In this special issue on bio-nano imaging and analysis, different microscopy techniques were used to characterize the structures of bio-nanomaterials, image nanoparticles in biological systems, study biological functions, or manipulate nanostructures (Figure 1). This special issue includes 13 articles from leading scientists in bio-nanotechnology and the microscopy community and covers the following four interesting topics: 1) use of nanoparticles as imaging probes, 2) manipulation of nanostructures using microscopy, 3) bio-inorganic hybrid nanomaterials imaging, and 4) imaging nanomaterials using fluorescence and single-molecule microscopy. In this special issue the first topic is about the use of nanoparticles as imaging probes. Four frequently used nanoparticles and their principal method of imaging are summarized in table 1. This section includes three review articles and one research article. The three review articles concern recent advancements in the application of gold nanoparticles, magnetic nanoparticles and quantum dots for bio-imaging. The research article presents a special method for labeling axonal transport with quantum dots. Subramanian Tamil Selvan et al, at the Institute of Materials Research and Engineering in Singapore have reviewed the recent advances in the synthesis and application of bimodal magnetic-fluorescent probes for bio-imaging (pages 563–576). Recent advances in imaging with nanoparticles, which include quantum dots, magnetic nanoparticles, rare-earth doped upconversion fluorescent nanoparticles, and multifunctional nanoparticles have been very rapid. These nanoparticles have not only enhanced imaging sensitivity, resolution, and specificity, but they have also allowed for simultaneous multi-targeting, monitoring, and enhanced diagnostics and delivery of therapeutic effects. In the second part of this article, molecular imaging modalities clinically used such as position emission tomography (PET), single photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), optical and ultrasound microscopy are summarized in a table along with the related imaging methods for the specific nanoparticles. Also described are recent advances in the assemblies of (1) superparamagnetic iron oxide (SPIO)-quantum dot (QD) based magnetic-fluorescent probes, (2) SPIO rare-earth (RE) based magnetic-fluorescent probes, (3) Gd-based magnetic contrast agents covalently attached to fluorescent probes, and (4) Gd-based MRI agents

and fluorescent probes in a single nanomaterial domain. This article should be important to those studying nanomaterials for bio-imaging. The next article by Jesús Ruiz-Cabello from Universidad Complutense de Madrid, Madrid, Spain described use of magnetic iron oxide nanoparticles and gold nanoparticles (GNPs) in MRI imaging and gene therapy (Pages 577–591). The magnetic nanoparticles are good contrast enhancement agents in MRI imaging. They can also be magnetically manipulated to guide delivery of genes into target cells for transfection. When GNPs are modified with either Gd supramolecular complexes or iron oxide, the new conjugates can also serve as contrast enhancement agents in MRI. More importantly, they elucidate the conjugation of these nanoparticles with biological molecules such as viruses to form nanobioconjugates. This article summarizes how these nanobioconjugates can improve the performance of the nanoparticles in MRI imaging and gene therapy. This article should be useful for those who are studying magnetic nanoparticles-based MRI imaging and gene delivery. The article by Eliza Hutter and Dusica Maysinger, McGill University in Canada, reviews the unique properties of GNPs and QDs, and how their properties benefit cellular and in vivo imaging (pages 592–604). GNPs have strong light scattering and surface plasmon enhanced luminescence, both of which can be used for bio-imaging. Light scattering by GNPs is usually visualized by dark-field microscopy and surface plasmon enhanced luminescence is most commonly monitored by two-photon luminescence microscopy. In the first part of this issue are described the physicochemical characteristics of GNPs, how to apply GNPs in the imaging of cells and animals, advantages of applying GNPs, and other potential applications of GNPs. QDs, which are stable, highly fluorescent, and tunable nanoparticles, can be further functionalized for specific applications. In the second part of this article, the authors reviewed the use of QDs as bio-imaging probes to image protein location at cellular or the intracellular organelle surfaces, to screen cancer markers in biological fluids, and to diagnose primary and metastatic tumors in vivo. This article introduces two very useful nanoparticles, luminescent QDs and plasmonic GNPs, VC 2011 WILEY-LISS, INC.

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