PDF - INTRODUCTION: BIO AND NANO IMAGING AND ANALYSIS - researchcub.infoResearch focusing onthe intersection of life sciences and nanotechnology is producing new fieldssuch as nanobiotechnology, nanobiology and nanomedicine. This interaction isoccurring in both directions. On one hand, biological molecules can be used tosynthesize and organize inorganic functional nanomaterials into well-definedstructures (Ma and others, 2008; Sotiropoulou and others, 2008; van Bommel andothers, 2003). On the other hand, nanomaterials can be used to study biologyand develop biomedicines. For example, labeled nanomaterials can serve aseffective longlasting dyes for bio-imaging (Lee and others, 2007; Medintz andothers, 2005; Xie and others, 2011) and nanomaterials are ideal drug-carriersfor the development of new drug systems (Dobson, 2006; Nakanishi and others,2009; Portney and Ozkan, 2006). Microscopy is a powerful tool that can imagebionanostructures, track nanomaterials in bio-systems, measure physicalproperties, determine compositions, and even create and manipulatenanostructures. In this special issue on bio-nano imaging and analysis,different microscopy techniques were used to characterize the structures ofbionanomaterials, image nanoparticles in biological systems, study biologicalfunctions, or manipulate nanostructures (Figure 1). This special issue includes13 articles from leading scientists in bionanotechnology and the microscopy communityand covers the following four interesting topics: 1) use of nanoparticles asimaging probes, 2) manipulation of nanostructures using microscopy, 3)bio-inorganic hybrid nanomaterials imaging, and 4) imaging nanomaterials usingfluorescence and single-molecule microscopy. In this special issue the firsttopic is about the use of nanoparticles as imaging probes. Four frequently usednanoparticles and their principal method of imaging are summarized in table 1.This section includes three review articles and one research article. The threereview articles concern recent advancements in the application of goldnanoparticles, magnetic nanoparticles and quantum dots for bio-imaging. Theresearch article presents a special method for labeling axonal transport withquantum dots. Subramanian Tamil Selvan et al, at the Institute of MaterialsResearch and Engineering in Singapore have reviewed the recent advances in thesynthesis and application of bimodal magnetic-fluorescent probes forbio-imaging (pages 563–576). Recent advances in imaging with nanoparticles,which include quantum dots, magnetic nanoparticles, rare-earth dopedupconversion fluorescent nanoparticles, and multifunctional nanoparticles havebeen very rapid. These nanoparticles have not only enhanced imagingsensitivity, resolution, and specificity, but they have also allowed forsimultaneous multi-targeting, monitoring, and enhanced diagnostics and deliveryof therapeutic effects. In the second part of this article, molecular imagingmodalities clinically used such as position emission tomography (PET), singlephoton emission computed tomography (SPECT), magnetic resonance imaging (MRI),optical and and ultrasound microscopy are summarized in a table along with therelated imaging methods for the specific nanoparticles. Also described arerecent advances in the assemblies of (1) superparamagnetic iron oxide(SPIO)-quantum dot (QD) based magnetic-fluorescent probes, (2) SPIOrare-earth(RE) based magnetic-fluorescent probes, (3) Gd-based magnetic contrast agentscovalently attached to fluorescent probes, and (4) Gd-based MRI agents andfluorescent probes in a single nanomaterial domain. This article should beimportant to those studying nanomaterials for bio-imaging. The next article byJesús Ruiz-Cabello from Universidad Complutense de Madrid, Madrid, Spaindescribed use of magnetic iron oxide nanoparticles and gold nanoparticles(GNPs) in MRI imaging and gene therapy (Pages 577–591). The magneticnanoparticles are good contrast enhancement agents in MRI imaging. They canalso be magnetically manipulated to guide delivery of genes into target cellsfor transfection. When GNPs are modified with either Gd supramolecularcomplexes or iron oxide, the new conjugates can also serve as contrastenhancement agents in MRI. More importantly, they elucidate the conjugation ofthese nanoparticles with biological molecules such as viruses to formnanobioconjugates. This article summarizes how these nanobioconjugates canimprove the performance of the nanoparticles in MRI imaging and gene therapy.This article should be useful for those who are studying magneticnanoparticles-based MRI imaging and gene delivery. The article by Eliza Hutterand Dusica Maysinger, McGill University in Canada, reviews the unique propertiesof GNPs and QDs, and how their properties benefit cellular and in vivo imaging(pages 592–604). GNPs have strong light scattering and surface plasmon enhancedluminescence, both of which can be used for bio-imaging. Light scattering byGNPs is usually visualized by dark-field microscopy and surface plasmonenhanced luminescence is most commonly monitored by two-photon luminescencemicroscopy. In the first part of this issue are described the physicochemicalcharacteristics 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 furtherfunctionalized for specific applications. In the second part of this article,the authors reviewed the use of QDs as bio-imaging probes to image proteinlocation at cellular or the intracellular organelle surfaces, to screen cancermarkers in biological fluids, and to diagnose primary and metastatic tumors invivo. This article introduces two very useful nanoparticles, luminescent QDsand plasmonic GNPs, VC 2011 WILEY-LISS, INC.

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