Published in final edited form as:
Adv Drug Deliv Rev. 2008 August 17; 60(11): 1225.

Advanced Drug Delivery Reviews Theme Issue:

"Inorganic Nanoparticles in Drug Delivery"

Vincent M. Rotello [Guest Editor]

Preface

Inorganic nanomaterials feature a wide variety of attributes that make them highly promising candidates for drug delivery. The inorganic component of these materials imparts unique properties to the resultant systems, providing access to new properties and capabilities for both delivery and imaging applications. Inorganic structures also provide scaffolds for the presentation and encapsulation of drugs, biomolecules, and imaging agents, generating delivery systems with structural and dynamic properties complementary to more conventional polymeric and lipid-based delivery vectors. The reviews in this special issue highlight both of these aspects, demonstrating the potential of these systems in biomedical applications.

One of the unique aspects of nanoparticles is quantum confinement, which provides optical properties such as fluorescence that differ completely from bulk materials. The use of quantum dots (QDs) as tools for imaging and therapeutics is reviewed by Nie *et al.*, covering issues of synthesis, functionalization, imaging, and toxicology. On the therapeutic side, the use of these systems as dual-mode imaging and delivery agents is covered.

Nanomaterials can be fabricated with a wide range of magnetic properties that likewise derive from their nanoscale dimensions. McCarthy and Weissleder discuss the use of magnetic nanoparticles for MRI imaging and therapeutic applications. This review cover a number of issues in the application of magnetic materials, including functionalization, targeting, multi-modal imaging (MRI and fluorescence) and near-IR activated therapeutics. Zhang et. al provide a complementary review of nanomaterials, covering the array of core materials available, and the use of polymers, liposomes, and core-shell structures for particle functionalization. Targeting of the carriers is also covered, including magnetic targeting strategies unique to these materials.

In addition to their physical properties, nanomaterials provide access to a diverse array of shapes and morphologies. Sailor et al. discuss the use of nanoporous silicon produced via etching of Si, including both silicon and silicate systems produced via oxidation of silicon precursors. In these systems the pores serves as carriers for drugs and polymers, while the microparticle 'mothership' can be used to target the therapeutic to disease sites. Lin et al. describes an entirely different approach to the creation of mesoporous silicates using self-assembly. A particular focus of this article is the use of 'gatekeepers', namely agents that cap the pores and can be triggered to release the payload.

A final aspect of nanomaterials arises from our ability to control the interface between nanomaterials and their environments. While this capability is used in the preceding articles,

it comes to the fore in the use of metallic nanoparticles in delivery applications. Bhattacharya and Mukherjee describe the behavior of ‘naked’ nanoparticles in vitro and in vivo, describing an array of targets. Rotello et al., in contrast, focus on the engineering of monolayer functionality on the particle. This review covers the effect of ligand design on payload release, in particular the use of the differential between extra-and intracellular glutathione levels. Additionally, the use of gold nanoparticles for photothermal therapy and the use of protein-particle conjugates as targeted therapeutics are described.

Taken together, inorganic nanomaterials have much to offer in biomedical applications. While there are clearly hurdles to be overcome in implementing these systems as delivery vehicles, their unique attributes and ease of production will make these nanosystems important additions to our toolkit.