TECHNOLOGY

Stimuli-Responsive Mesoporous Nanomaterials

OVERVIEW

Background
Current chemotherapy treatments are effective in eradicating cancer cells, but the lack of tissue specificity severely limits the dosage that may be used to combat the disease. Traditionally, chemotherapy drugs have achieved selectivity by disabling processes that occur more frequently in cancer tissues than in healthy tissues. This approach is severely limited, however, because although cancer cells are preferentially affected, healthy tissues are still damaged to a significant extent depending on the selectivity of the drug treatment. Therefore, in traditional chemotherapy, the strength of cancer drugs that can be used is limited by adverse effects to healthy tissues necessary for sustaining life. One of the potential solutions to this problem is to employ targeted delivery coupled with stimuli-specific cellular response to ensure high selectivity. If successfully applied, this approach would allow one to use chemotherapy agents with high toxicity while still avoiding side effects, since the drug would never be delivered to normal tissue.

Researchers at the University of Maryland have developed a novel method for the synthesis of mesoporous silica nano-shells (MSN) that are well-suited for both drug delivery and diagnostic applications. These shells can be filled with chemotherapy agent then coated to prevent release until the appropriate stimulus is provided. MSN are ideally suited for this application because they have low cytotoxicity in vitro, robust chemical functionalization possibilities, easily manipulated morphological characteristics, simple target material loading, and physiologically relevant (pH and temperature) release profiles. Cytotoxicity studies have shown MSN to be relatively non-cytotoxic in healthy human endothelial cells, as well as human breast cancer cells. In addition, functionalization of MSN with physiologically relevant bioconjugates (DNA, peptides, and oligosaccharides) is readily achieved and allows for specific cellular targeting, suggesting great potential for MSN in targeted drug delivery. The particles are also ideal candidates for diagnostic applications since they can be filled with virtually any fluorescent dye or dye mixture. A patent application is pending.

Advantages
• MSN drug delivery system targets abnormal cells with more specificity than existing techniques, leaving healthy tissue relatively unaffected
• Non-toxic
• Size and shape of particles easily manipulated
• Differential functionalization of bioconjugates
• Brightness of fluorescence-filled particles exceeds that of quantum dots

Applications
• Disease diagnostics
• Targeted drug delivery
• Imaging
• Sensors

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Additional Information

INSTITUTION

University of Maryland, College Park

PATENT STATUS

Patent(s) pending

LICENSE STATUS

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CATEGORIES

- Nanotechnology + Nanoparticles + Nanomaterials
- Imaging devices

EXTERNAL RESOURCES

- US Patent 9,271,936

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