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Exploring the Impact of a Nanostructure's Size and Shape on Cellular Uptake, Clearance, and Metabolism

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Abstract

Novel discoveries on molecular differences between diseased and healthy cells and tissues and developments of nanotechnology probes and tools are transforming the way we treat and diagnose disease. Biological molecules provide a means to direct nanostructures to diseased site where the nanostructure optically, electrically, or magnetically light up or treat the diseased site. A key to this hybrid research field is the ability to engineer nanostructures with defined properties. Essentially, a nanostructure provides a system that has custom-tunable function based on its size and shape. Recently, we and others have demonstrated the use of such nanostructures for cell, tissue, and animal imaging and therapeutic applications for the early detection and treatment of cancer. The interface of these two fields has prompted us to address several important questions. These questions include: Are the nanostructure's toxic? How does a cell process these nanostructures? What is the fate and clearance of these nanostructures? Are these processes related to the dimensional or surface chemical characteristics of the nanostructures? These fundamental questions must be answered before nanostructures become useful for clinical applications. In this presentation, we discuss techniques and research results in elucidating these fundamental questions. We will discuss the size and shape-dependent uptake of the nanostructures in cell cultures and in animals using model nanostructures. The results from these studies provide guidance for the design of nanostructures for biomedical applications.

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