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The importance of chemistry in creating well-defined nanoscopic embedded therapeutics: Devices capable of the dual functions of imaging and therapy

Published in Accounts of Chemical Research (2011) ASAP

Nanomedicine is a rapidly evolving field, for which polymer nanoparticles can be used as devices that provide enhanced diagnostic imaging and treatment of disease, known as theranostics. Theranostics also offer external surface area for the conjugation of ligands to impart stealth characteristics and/or direct their interactions with biological receptors and provide a framework for conjugation of imaging agents to track delivery to diseased site(s). The incorporation of such multiple functions is complicated, requiring exquisite chemical control during production and rigorous characterization studies to confirm the compositions, structures, properties, and performance.

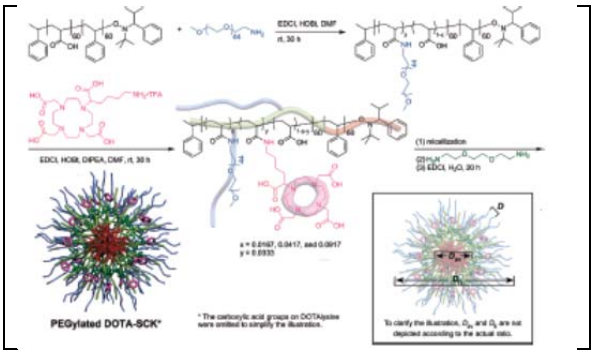
Introduction

Since nanotechnology met medicine a new area of research have evolved termed nanomedicine. In nanomedicine research we have learned that nanoscopic structures can be utilized for both drug delivery applications, to reduce toxic side-effects and to increase tissue specific uptake, as well as utilized in diagnostic imaging applications, were the nanostructures can modulate how contrast agents circulate and can generate superior resolution.

The next step in nanomedical applications are theranostics, a combination of the words therapy and diagnosis, were one employs nanoscale systems capable of delivering a therapeutic while imaging the tissue were the pharmaceutical is delivered, or follow the response in tissue as an effect of the drug delivery.

In this work we highlight the importance of chemistry and the control of physochemical properties necessary to develop theranostic nanoparticles. In particular we focus our attention on shell crosslinked knedel-like (SCK) polymeric nanoparticles and how rapid efficient and orthogonal (REO) chemistry must be employed to facilitate the placement of function on the theranostic nanocarrier.

Conclusions: The primary advantage of theranostics is that they are not limited to therapy or imaging, but allow for combinations, to give coincident diagnostic information plus delivery of therapeutics. Nanoscopic objects serve as scaffolds that have the optimum, intermediate size between the molecular level and microscopic materials, to provide domains for high capacities of therapeutic loading and sites for labeling, while also having high surface areas for the presentation of targeting ligands. Although imaging of the nanoscopic device and delivery of a molecular therapeutic does not offer dual tracking of each independently, having information about the conditions under which the therapeutic is released and the ability to monitor the nanostructure gives some indication of the theranostic benefit.



Theranostic SCK nanoparticles for PET imaging applications.

Literature

Karen L. Wooley, and Andreas M Nyström. (2011) The importance of chemistry in creating well-defined nanoscopic embedded therapeutics: Devices capable of the dual functions of imaging and therapy. Accounts of Chemical Research, 2011. Pubmed id: 21675721.

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