Mesoporous Silicon in Degradable Drug Delivery Systems

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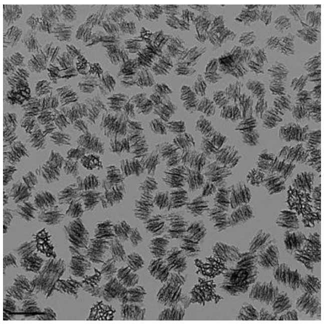
This presentation will discuss the challenges associated with long-acting controlled release systems and peptide-targeted nanoparticle delivery systems based on mesoporous silicon. For many decades, applications in microelectronics, solar energy harvesting, secondary batteries, and chem/bio sensing have driven development of the chemistry of crystalline silicon.[1] These applications have emphasized maximizing long-term stability, under demanding chemical environments.[2] More recently, applications in nanomedicine have reset the requirements substantially; to be useful in this domain, the silicon-based material often must dissolve smoothly and slowly, or in response to precisely defined triggers.[3, 4] The effective trapping and the retention of function of biologic molecules (proteins and nucleic acids) within the confines of a mesoporous silicon nanostructure will be discussed. Because of their sensitive nature, biologics must use trapping chemistries that operate under mild conditions to immobilize and confine the biologic without inducing denaturation or hydrolytic decomposition. This presentation will focus on the influence of materials and chemical parameters on the performance of mesoporous silicon microparticles and nanoparticles in vitro and in vivo.

References

[1] M.J. Sailor, Porous Silicon in Practice: Preparation, Characterization, and Applications, Wiley-VCH, Weinheim, Germany, 2012.
[2] M.J. Sailor, Chemical Reactivity and Surface Chemistry of Porous Silicon, in: L. Canham (Ed.) Handbook of Porous Silicon, Springer International Publishing, Cham, 2014, pp. 355-380.
[3] J.R. Henstock, L.T. Canham, S.I. Anderson, Silicon: The evolution of its use in biomaterials, Acta Biomater., 11 (2015) 17-26.
[4] L.T. Canham, Porous silicon for medical use: from conception to clinical use, in: H.A. Santos (Ed.) Porous Silicon for Biomedical Applications, 2014, pp. 3-20.

Figures



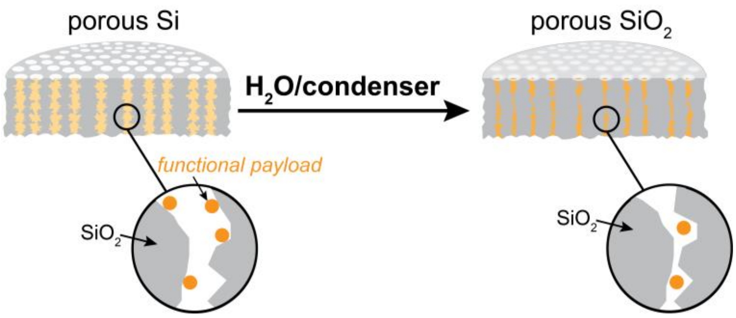


Figure 1: Left: Porous silicon nanoparticles by TEM. Nominal particle size is 200nm. Right: Porous silicon nanoparticle design, showing a notional aqueous condenser chemistry used to physically trap a functional payload.