Mesoporous silica nanoparticle-based protein delivery systems for biomedical applications
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Citation

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**Issue Date:** 2016-12-21
1. Proteins used as a therapeutic are usually characterized by their short plasma half-life, high elimination rate, limited ability to cross cell membranes, and poor bioavailability through intestinal administration. Chapter 1, this thesis.

2. It was shown that phospholipid membranes are able to assemble into different structures upon contact with a hydrophilic surface, involving vesicle adsorption, rupture and spreading into planar membranes. Chapter 1, this thesis.

3. Small (< 200 nm) MSNs with ordered large pores (> 5 nm), capable of encapsulating therapeutic small molecules suitable for delivery applications in vivo, are rare however. Chapter 2, this thesis.

4. Encapsulating proteins in MSNs is still challenging however, and only a few publications concerning the design of MSNs with a morphology that enables the effective encapsulation of a broad range of proteins are available. Chapter 2, this thesis.

5. Most of the current vaccines are delivered by intramuscular or subcutaneous injection, but the inherent limitations are obvious, such as the risk of the needle-related disease induced by reusing needles and syringes, the needle fear by children and patients, and the need for maintaining a proper cold chain during storage and transport. Chapter 3, this thesis.

6. Protein delivery into the cytosol of cells is a challenging topic in the field of nanomedicine, because cellular uptake and endosomal escape are typically inefficient, hampering clinical applications. Chapter 4, this thesis.

7. Mesoporous silica nanoparticles (MSNs) can be used as protein delivery carriers due to their unique properties, namely biocompatibility, chemical inertness, large surface area and controllable pore size. Chapter 5, this thesis.

8. In (bio)nanotechnology, individual nanoparticles are as unique as people’s fingerprints, therefore it becomes imperative to find methods for the full characterization of nanoparticles. Chapter 6, this thesis.