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Synthesis of thin shell hollow mesoporous silica nanoparticles through PEI-etching strategy for vaccine adjuvants

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In the therapy of both infectious diseases and cancer, especially metastatic diseases, a robust and long-lasting antiviral and antitumor immune response is central for both prevention and therapy. Effective vaccines require appropriate adjuvants that enhance antigen immunogenicity and elicit antiviral and antitumor immune responses. The biomaterials, which can be used as vehicles and adjuvant, have gained increasing attention, by not only improving antigen delivery efficiency, but also enhancing specific immune responses. Hollow Mesoporous silica nanoparticles (HMSNs) have good biocompatibility, high surface areas, uniform pore structure, easily tunable particle sizes, morphology, and surface properties and especially intrinsic adjuvant activity. Meanwhile, Polyethylenimine (PEI) has been reported to show immune-potentiating action. Herein, we have designed and generated a kind of HMSNs with uniform thin shell (denoted as P-THMSNs) through PEI-etching method. The as-prepared P-THMSNs in the presence of PEI have large surface area, high pore volume, and controllable structure parameters. Our study demonstrated that PEI plays critical roles in forming the thin shell hollow mesoporous structure. PEI acts as the protecting agent, etching agent and soft template for the generation of P-THMSNs. The proposed formation mechanism is that the surface of SiO_2 was protected by PEI and the inner SiO_2 was etched by PEI, followed by the redeposition of dissolved silica species directed by PEI. Furthermore, the strategy is general to transform silica or silica-coated composite materials into hollow or rattle structures with ordered mesoporous shell. The *in vivo* investigation indicated that P-THMSNs showed no significant cytotoxicity and did not cause remarkable tissue damage on kidney, liver, spleen and lung. Compared with HMSNs, T-PHMSNs stimulated DC maturation more efficiently both *in vitro* and *in vivo*. Thus, P-THMSNs can be regarded as promising vehicles and adjuvants in the formulation of novel vaccines.

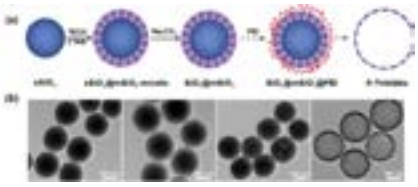

Figure 1: (a) Schematic illustration showing the formation process of P-THMSNs.
(b) TEM images of sSiO2, sSiO2@mSiO2-miccle, SiO2@mSiO2 and P-THMSNs (from left to right).

Biography

Qianqian Liu got her Bachelor's degree in Chemistry from Henan Normal University in China. Currently, she is a PhD candidate from Huazhong University of Science and Technology in China. Her research interest focuses on the design and fabrication of drug delivery vehicles for cancer therapy.

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