Smart Soft-Templating Synthesis of Hollow Mesoporous Bioactive Glass Spheres

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The discovery of bioactive glass (BG) has brought a new therapeutic revolution in bone implantation and inspired the rapid development of synthetic strategy of bioactive nanomaterials, which have similar in compositions to bone with biodegradable feature. Different morphologies of mesoporous bioactive glass (MBG) including spheres, monoliths, and films have already been reported.[1] While, control the diameter under an proper size for using as drug carriers is still a challenge. Our previous work on the synthesis of hollow mesoporous silica nanoparticles,[2] inspires us to prepare hollow mesoporous bioactive glass (HMBG) spheres following the same concept of using a dual soft-template system.

Here, we report a direct synthesis of a novel type of HMBG spheres by using a dual-template system, including a diblock copolymer poly(styrene-*b*-acrylic acid) (PS-*b*-PAA) and a cationic surfactant cetyltrimethylammonium bromide (CTAB) (**Figure 1**).[3] Several polymeric micelles aggregate together to form a hollow interior and electrostatically bounded CTAB with polymeric micelles forms mesochannels on the shell after calcination. Such advantages have never been realized for the synthesis of hollow MBG spheres by controllable self-assembly of two soft-templates based on colloidal chemistry. The obtained HMBG spheres display a uniform diameter of *ca.* 250 nm. An interior hollow center with the size of *ca.* 150 nm is composed of several discrete mesopores (*ca.* 20 nm), while the thickness of the exterior mesoporous shell is *ca.* 50-60 nm. Drug adsorption and release experiments ascertain that the HMBG is a suitable carrier attributing to high drug loading capacity (830 $mg \cdot g^{-1}$, normalized by sample amount) and releasing the drug in sustainable way. Additionally, the formation of HA on the surface of HMBG spheres makes their potential application in bone regeneration with effective loading of drug and active agents. Our synthetic concept is widely applicable for preparation of other crystallized porous materials. Our recent advance will be presented as well.[4-5]

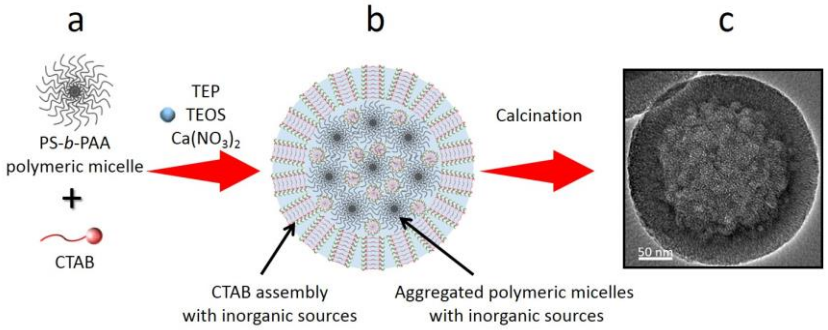

Figure 1 Formation process of uniformly-sized hollow mesoporous bioactive glass spheres.

Reference:

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[4] Y. Li, Y. Yamauchi *et al.*, *Eur. J. Chem.*, **20**, 6027-6032 (2014); *Angew. Chem. Int. Ed.*, under revision.
[5] B. P. Bastakoti, Y. Li, Y. Yamauchi *et al.*, *Chem. Commun.*, **50**, 9101-9104 (2014); *Small*, **11**, 1992-2002 (2014); *Angew. Chem. Int. Ed.*, **54**, 4222-4225 (2015).