Polymer Cubosomes: Synthesis, Self-Assembly and Conversion to Functional Materials

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The self-assembly of block copolymers is nowadays well understood. The resulting block copolymer morphology is mainly influenced by the packing parameter $p = v/a_0 l_c$; where v and l_c are the volume and the length of the hydrophobic block, and a_0 is the surface area of the hydrophilic block. If p < 1/3 spheres are formed,for 1/3 < p < 1/2 cylinders are found, and a 1/2 < p < 1 will result in vesicles.[1,2] Exceeding a p > 1 results in the formation of cubosomes and hexosomes.[2] The polymer cubosomes have a bicontinuous pore network and a high surface area, therefore they can be used as templating platform for different materials like metal oxides and MOFs to introduce high surface area and ordered porous structure.[3,4] Herein, we show the synthesis of poly(ethylene oxide)-based amphiphilic block copolymers via RAFT polymerization, discuss the influence of chain lengths and cosolvent on the self-assembly process. We also present an alternative formation route (redispersion) to the commonly used nanoprecipitation method. The resulting poylmer cubosomes are be used as a templating platform for TiO_2, Co_3O_4 and porous carbon.

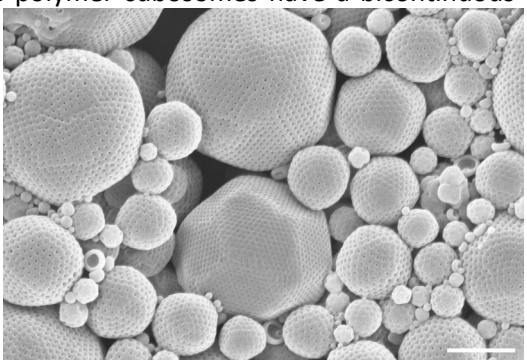

Figure 1. SEM image of block copolymer cubosomes. (scale bar 1 µm).

Keywords: block copolymers, mesoporous materials, metal oxides, self-assembly, templating

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References

[1] Mai, Y.; Eisenberg, A. Self-assembly of block copolymers. *Chem. Soc. Rev.* **2012**, *41* (18), 5969–5985.
[2] Chen, H.; Li, M.-H. Recent Progress in Polymer Cubosomes and Hexosomes. *Macromol. rapid Commun.* **2021**, *42* (15), e2100194.
[3] Xie,W.; Huang, X.; Zhu, C.; Jiang, F.; Deng, Y.; Yu, B.; Wu, L.; Yue, Q.; Deng, Y. A Versatile Synthesis Platform Based on Polymer Cubosomes for a Library of Highly Ordered Nanoporous Metal Oxides Particles. *Adv. Mater.* **2024**, 36, 2313920.
[4] Li, C.; Pan, Y.; Xiao, T.; Xiang, L.; Li, Q.; Tian, F.; Manners, I.; Mai, Y. *Angew. Chem. Int. Ed.* **2023**, 62, e202215985; *Angew. Chem.* **2023**, *135*, e202215985.