EEFICIENT POLYMER TEMPLATES FOR TAILORING PROPERTIES OF FUNCTIONAL ORDERED MESOPOROUS MATERIALS

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ABSTRACT:

Ordered mesoporous materials resulting from the synergy between supramolecular templating and sol-gel processes exhibit unique porosity and surface properties, which make them very attractive as drug delivery systems, sensors, adsorbents or catalysts. We have investigated the use of PolyIon Complex (PIC) micelles as structure-directing agents for mesoporous materials with the objective to enlarge the potential of templates in tailoring the functional properties of mesoporous silica. PIC micelles are peculiar assemblies, which exhibit not only novel self-assembly behavior but also rich functional properties that could be conferred to mesoporous materials. The introduction of polymers in mesopores remains a challenging task, compared to functionalizing mesopores with organic or organometallic functions. Post-functionalization routes hardly succeed in providing homogeneously distributed polymer chains with controlled chemical function, polymer block length and function density. The use of PIC micelles can overcome those problems. PIC micelles obtained by electrostatic complexation between a double-hydrophilic block copolymer and a polyelectrolyte of opposite charge are dynamic assemblies, whose formation is reversible in water depending on pH and ionic strength. We have shown that their use allows the preparation of a variety of structures ordered at the mesoscale including 2D-hexagonal, lamellar, and 3D cage-like structures. The identification of such a variety of hybrid PIC-silica mesophases revealed for the first time the rich mesogenic properties of PIC micelles. The use of PIC micelles also allowed for the direct preparation of homogeneous polymer-functionalized mesoporous structures after elution of the polyelectrolytes in water, which can be recovered and recycled. The removal of the polyelectrolytes also allows generating mesoporosity. Another great benefit of using PIC micelles is that the ability to finely tune the affinity for silica of the corona polymer blocks allows the preparation of colloidal particles. Finally this route could be extended to periodic mesoporous organosilicas whose interest in biomedical applications was evidenced.

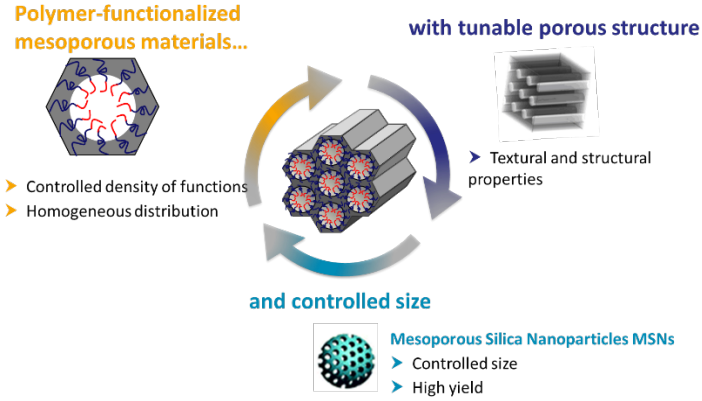

Figure 1: Mesoporous silica nanomaterials with tailored properties

References

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