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HAIRY NANOPARTICLES AS BUILDING BLOCKS FOR NANOPOROUS MEMBRANES

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Nanoporous membranes attract increasing attention due to their applications in molecular separations, biosensing, drug-delivery and catalysis. Many of these applications require control over the nanopore size with a narrow size distribution and the ability to further modify the membrane surface. Most currently used membranes are formed by introducing pores into bulk materials in a variety of irreversible processes. Membranes formed from nanoparticles using non-covalent interactions, on the other hand, are capable of reversible assembly which could prove useful for fabrication, processing, cleaning, reusing and would possess facile control over the membrane porosity and nanopore surface properties. This talk will describe the preparation and characterization of durable, reversible nanoporous ultrafiltration membranes with controlled thickness, area and pore size by self-assembly of silica nanoparticles grafted with polymer brushes (hairy nanoparticles, HNPs). The nanoparticles used to form the membranes were prepared by first modifying their surface with 2- bromoisobutyryl bromide (ATRP initiator). The pSPM-r-pEEMA, pDMAEMA-r-pMMA, pSPM, pHEMA, pHEMA-r-pSPM and pSPM-r-pEEMA brushes were grown on the surface of silica spheres using ATRP. We prepared three types of HNP membranes: membranes made of HNPs grafted with polymer brushes carrying acidic and basic groups, membranes in which the grafted polymer brushes have neutral groups, and membranes grafted with negatively charged polymer brushes. Depending on the HNP building block type the membranes are stable in most organic solvents and easily disassemble in water, or water-stable and capable of disassembly in organic solvents. All types of membranes are nanoporous and capable of size-selective transport and ultrafiltration. We will also describe the formation of nanoporous membranes from HNPs grafted with copolymer brushes carrying functional groups in the side chain, and combining reversibility with ultrafiltration, charge selectivity and affinity properties.

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