Spontaneous Formation of Nanoscale Polymer Spheres, Capsules, or Rods by Evaporation of Polymer Solutions in Cylindrical Alumina Nanopores

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In this study, we report for the first time the fabrication of polymer nanospheres, nanocapsules, and hemispherically capped nanorods simply through the wetting of anodic aluminum oxide (AAO) membranes with polymer solutions. For the wetting with polystyrene solutions, we have demonstrated that the formation of nanorods is dependent upon the solvents used (e.g., tetrahydrofuran and methyl ethyl ketone) which have strongly adsorbent nature towards alumina surfaces, displaying no correlation to molecular weight. More importantly, we have shown that there is a coarsening process from spheres to capsules to rods in AAO cylindrical nanopores during solvent evaporation. The coarsening process could serve as the formation mechanism for nanorods which replicate AAO cylindrical nanopores without considerable volume shrinkage. Our observation also provides a facile approach for fabricating polymer nanospheres and nanocapsules that can be concomitantly assembled into ordered arrays.