Nanoporous Membrane for Implantable Drug Delivery

E.E.Nuxoll[1], M.A.Hillmyer(PI)[2] & R.A.Siegel(PI)[1,3]
[1]Pharmaceutics, [2]Chemistry & [3]Biomedical Engineering, University of Minnesota

The Challenge: Protect an implanted drug reservoir from fouling immunoproteins without inhibiting diffusive release of the drug.

The Strategy: Use a membrane with pores so small (~30nm) they will block immunoproteins but short (~100nm) and straight enough to allow free passage of small molecules.

Tri-block copolymer of (PS-PI-PLA)

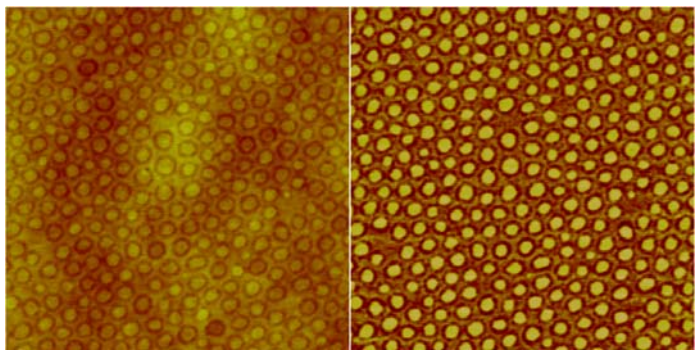
Poly(styrene)-poly(isoprene)-poly(lactic acid)

Morphology with PI-clad cylinders of PLA 30 nm across

Cylinders span the thickness of the film.

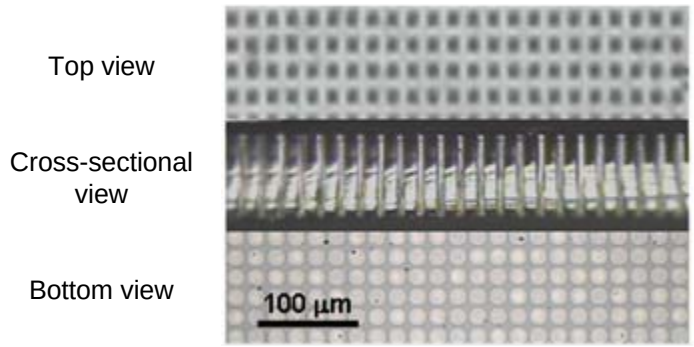
Cylinders are selectively etched away

Result: PS membrane with 30 nm PI-lined pores



Tapping-mode AFM image of PS-PI-PLA block copolymer film spin-coated and annealed on a low-stress silicon nitride substrate. The phase image is on the right; the yellow PLA cylinders are surrounded by a red ring of PI in an orange PS continuum.

The block copolymer is far to fragile to use by itself. To support it we have developed a microporous silicon support with 10um pores, over which we place our nanoporous membrane



Views of a microporous support with 10 μm square pores. In the top view, the pores appear as dark squares. In the cross-sectional view, they are tall, bright rectangles. Additional reflected light appears between the rectangles due to the fracture facets of the silicon. In the bottom view, the pores are covered by a thin layer of silicon nitride, making them appear lighter than the surrounding matrix. The round pore appearance is a result of footing at the nitride interface