The Creation of Nano-channels via Block Copolymers

Xuefa Li, Cayce Butler, Edward Hutchins
Prof. Sol M. Gruner
Prof. Christopher K. Ober

Department of Physics
Department of Materials Science and Engineering
Cornell University
**Goal:** To create 3-dimensional, uniform sized nano-channels in a large scale via block copolymer with labile block using a robust way.

**Potential Application:** The nanoporous materials can be used for many exciting technologies because of its nano-scale size, periodic nature and large surface area. Exciting physical, electrical and magnetic properties may be obtained when microdots of metal, semiconductor or superconductor are deposited in these nano-channels.
The way toward our goal...

**Step 1:** Create hexagonally packed cylindrical morphology by controlling the weight ratio of two blocks @1:3.

**Step 2:** Crosslink the double-bonds in PI matrix phase by shining UV, in order to fix the morphology and avoid the collapse in next step.

**Step 3:** Depolymerize poly(α-methyl styrene) cylindrical phase via heating to create nano-channels in the polymer film.
SAXS Set-up and Shearing Device

- SAXS is employed to probe the morphology, structural orientation and morphology development with temperature in the bulk of materials.
- The shearing device is built to orient the bulk morphology into a specific direction in a controlled manner.
TEM for PαMS-PI: highly-ordered cylinders

- Cast film from toluene and then microtome.
- Stain poly(isoprene) with OsO4 prior to TEM.
- Darker phase is poly(isoprene) block, and lighter phase is poly(α-methyl styrene) block.
- Microdomain size ~360 Å
TEM of PαMS-PI after Treatments: Nano-channels!

- Cast film from toluene.
- Shine UV first to crosslink poly(isoprene) matrix phase.
- Heat the sample and depolymerize poly(α-methyl styrene) cylindrical phase to create nano-pores.
- Microtoming and no staining prior to TEM.
- Nano-channel diameter ~100 Å.

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