# Responsive filtration membranes by polymer self-assembly

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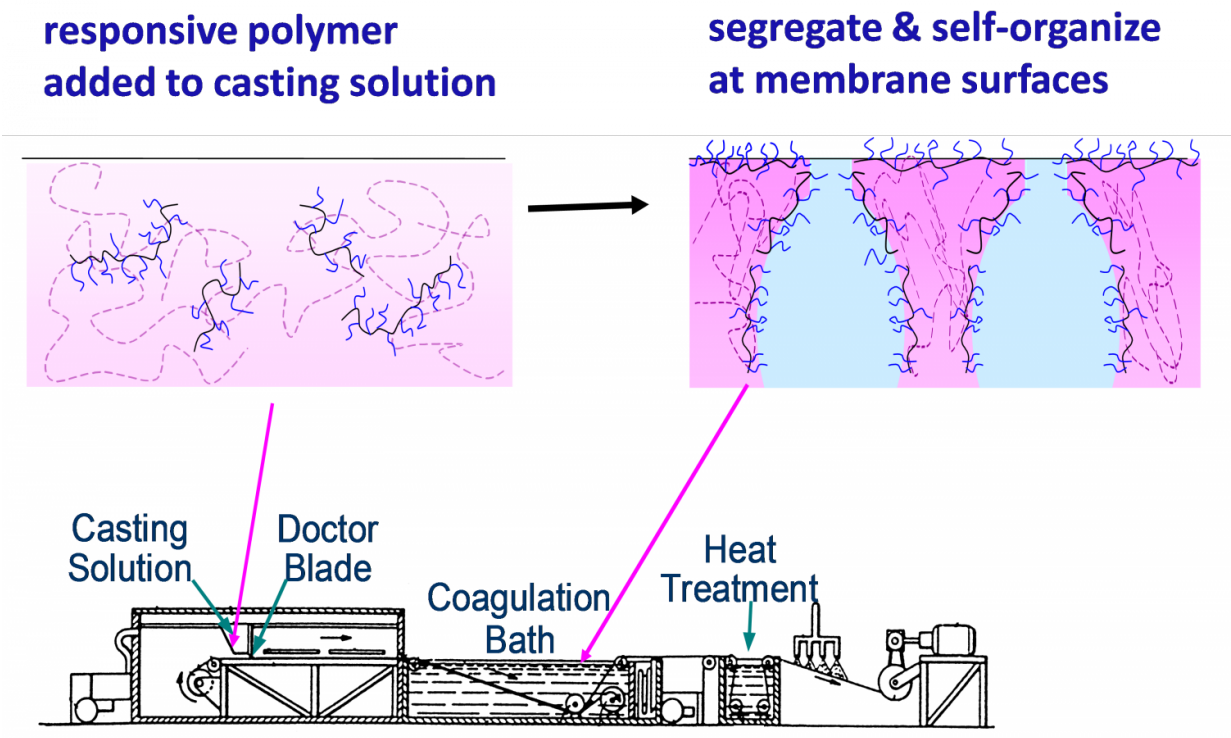


Schematic description of the non-solvent induced phase separation (NIPS) membrane casting in the presence of an amphiphilic responsive copolymer additive. Credit: *Technology*

Polymer self-assembly is a crucial tool for manufacturing membranes using scalable methods, enabling easier commercialization. This review surveys approaches to impart stimuli-responsive behavior to membrane

filters using polymer self-assembly.

A team of researchers from Tufts University in Medford, Massachusetts have published a review article discussing recent developments in stimuli-responsive membranes, with an emphasis on membranes manufactured by polymer self-assembly. The article describes the state-of-art stimuli-responsive membrane manufacturing processes and explains their stimuli-responsive behaviors. In the end, an overview of future development and challenges in this field is highlighted. The subject covered by the review article is a new and promising field. The report appears in the December 2016 issue of the journal *Technology*.

Today, the most common method of manufacture for most ultrafiltration (UF) membranes is the non-solvent-induced phase separation (NIPS) process. In NIPS, a polymer solution is cast on a solid substrate, and then immersed in a coagulation bath filled with a non-solvent or a mixture of non-solvents (Figure 1). The non-solvent in the coagulation bath diffuses into the polymeric solution and the solvent diffuses into the non-solvent bath in de-mixing process, which essentially is an exchange between the solvents. UF membranes with their nanometer-scale pores allow for the size-based separation of different components. Yet, all NIPS-prepared membranes with mesoporous skins display a fairly broad pore size distribution in their selective layer, which is a bottleneck in selectivity for size-based separations.

Polymer self-assembly, in which polymer chemistry and physics act in concert to create well-defined nanometer-scale features acting as pores, offers the benefit of improved size-based selectivity. Several researchers have investigated processes that are scalable and compatible with the conventional NIPS process that take advantage of this.

Membrane preparation by NIPS using stimuli-responsive polymers, copolymers, and polymer-additive mixtures is an attractive approach in

developing responsive membranes. The conformation/polarity/reactivity of responsive polymers or functional groups integrated in the pore structure changes in response to the stimuli they are designed for, enabling their use in systems or devices that require switchable, on-demand material properties.

Based on the particular behavior and application, polymers can be custom designed to respond to different external stimuli such as temperature, pH, magnetic or electric fields, ionic strength, added saccharides, antigen binding, or light. Furthermore, membranes that respond to multiple types of stimuli can be developed by incorporation of different stimuli-responsive functionalities in the polymer, to respond, e.g., to both pH and temperature.

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