365a Polyester-Polyelectrolyte Nanocomposite Membranes as Breathable and Responsive Barriers

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Materials for protective clothing are required to be both breathable (to provide comfort and reduce heat stress) and barriers to harmful agents (i.e., highly selective membranes). In addition, their mechanical properties should be comparable to those of textile materials. Until now, no technology has satisfied all these requirements. In this work, a new class of polymer membrane was explored. This membrane is based on a polymer-polymer nanocomposite of a hydrophilic polyelectrolyte grafted within a nanoporous hydrophobic polymer host matrix. The hydrophobic host matrix provides mechanical strength, durability, flexibility, and barrier properties, while the polyelectrolyte provides high water vapor permeability with stimuli-responsive traits for size-exclusion of toxic chemicals.

Nanocomposites consisting of polyester track-etched (PETE) nanoporous membrane and polyelectrolyte (poly(methacrylic acid) and poly(2-acrylamido-2-methyl-1-propanesulfonic acid)), were prepared by a graft copolymerization technique. Compared to the poly(ethylene terephthalate) dense membrane, selective transport of water vapor over dimethyl methylphosphonate vapor was increased by 12 times for both nanocomposites. The water vapor transmission rates were 2 to 4 times higher than the acceptable breathable region, indicating that these PETE-polyelectrolyte nanocomposites could be promising materials for comfortable chemical protective clothing. Synthesis methods of the nanocomposites, including the content of polyelectrolyte, distribution and size of the nanopores, will be optimized in relation to transport properties.