Novel Perfluoropolyethers as Fouling-Release Coatings.

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Perfluoropolyethers (PFPEs) and copolymers exhibit low surface tensions, low moduli and excellent thermal and chemical stabilities, which make them promising candidates as fouling-release coating materials. The objectives of this research primarily involve functionalizing PFPE precursors to form reactive macromonomers which can be photochemically crosslinked to form elastomer materials. To explore structure/property relationships, different functional endgroups such as methacrylate and styrene were used to modify PFPE telechelic diols of variable molecular weights to yield crosslinkable difunctional PFPE macromonomers. The method allows for control of the crosslink density of crosslinked PFPE elastomer materials via UV curing, which can provide materials with different mechanical and surface properties. These difunctional PFPEs were incorporated into hydrophilic dimethacrylate-functionalized poly(ethylene glycol) (PEG-DMA) to form amphiphilic networks via UV curing. These network materials varied from optically transparent to opaque as a function of molecular weight and composition ratio. The different solubility of these two components resulted in the amphiphilic materials with microphase to macrophase separation. Strong inhibition of non-specific protein adsorption could be achieved with these network materials compared with an oligo(ethylene glycol)-based self-assembled monolayer coated surface. Multifunctional PFPE macromonomer was obtained via the modification of PFPE tetrol precursor with methacrylate endgroups. In order to achieve durable PFPE elastomer materials, fluorinated difunctional crosslinker was incorporated and copolymerized with the PFPE macromonomer to further increase crosslink density. The partial incompatibility of the two components resulted in samples with microphase separation. This fundamental research helps both to understand the compatibility and miscibility behavior of fluorinated components and to optimize the design of perfluorinated systems for obtaining enhanced mechanically durable materials as long-term fouling-release coatings.