Whether synthetic or biological in origin, membranes are of critical importance to countless processes that impact our lives, or even regulate life itself. For example, synthetic membranes are often used in challenging industrial separations, such as the purification of natural gas feedstocks, production of nitrogen from atmospheric air, hydrogen recovery in synthesis gas plants, and even the removal of harmful greenhouse gases from our atmosphere. On the other hand, lipid membranes that envelop our cells contain thousands of protein complexes that regulate and perform essential biological functions. The fundamental understanding of the biological role of these proteins is crucial to many ongoing research efforts, such as targeted drug design. The Long Research Group strives to harness the power of polymer chemistry to develop improved fundamental understandings within these aspects of membrane science: the design and synthesis of functional polymeric membranes (make it) and the use of amphiphilic copolymers for the controlled disruption and extraction of biological membranes (break it). More specifically, we will show our progress toward the design of substituted polynorbornene-based materials for the separation of greenhouse gases and purification of natural gas, as well as the development of next-generation styrene-maleic acid copolymers to facilitate enhanced trans-membrane protein extraction efficiencies and probe its mechanistic details.

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