Connecting the dots: membrane formation-morphology-performance studied with simplified models and microfluidic platforms

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Membrane functionality – selectivity and permeability – is intimately linked with the structure and morphology of the membrane material(s), spanning truly molecular scales through the nano-scale and up to features the size of many microns. These structures are, in turn, a direct outcome of the processes employed for the fabrication of the membrane; notable examples are phase separation and interfacial polymerisation. Recent modeling efforts have been made at linking membrane structure, particularly its porous morphology, to membrane performance, using simplified models that attempt to capture the essential features of the problem. These efforts are part of a more holistic vision that aims at providing design guidelines in an attempt to reduce the parameter space to be tested empirically. Furthermore, experimental setups, based on microfluidic platforms, are being developed as a complimentary path, whose aim is two-fold: (a) provide a means for direct and rapid observation of membrane structures and a rapid-prototyping environment, and (b) allow in-silico measurements and characterization of membrane properties.