Self assembling pore networks: high order curvature driven flows

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Abstract: Energy conversion devices, such as fuel cells, lithium ion batteries, and photocatalytic devices operate by selective conduction of charged ions through a membrane. The membranes are created by emerging polymer electrolytes in a solvent in which the polymers spontaneously form nanoscale pore networks which serve as primitive ion channels.

I this talk, I present a novel model for the self-assembly of the nanoscale pore network as a gradient flow along classes of competing interfacial and bending energies. I present a sharp interface analysis of the model, and show that the evolution laws for the pores are given by high-order Ricci-curvature flows, coupled to interfacial dynamics.

We use our model, in conjunction with experimental scattering data, to study the morphology of Nafion, the industry standard polymer electrolyte membrane used in fuel cells.

This is a joint work with Keith Promislow.