Abstract Submitted
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Elastic, random pore network model for polymer electrolyte membranes[1] PETER BERG, PHILIPPE NADON, University of Alberta — We present the first attempt at describing the flow of water and protons through polymer electrolyte membranes (PEM) by use of an elastic pore network model. The main feature of our approach lies in the interplay between fluxes and pore structures, determined by randomized pore properties, the elasticity of the pores, and the liquid pressure distribution across the network. Closed-form solutions of the Poisson-Nernst-Planck-Stokes equations along each bond (pore) are employed and coupled to a swelling model for the pores which are embedded in the elastic PEM backbone. All parameter values are taken from the literature, leaving little room for the fitting of model results to literature values. The resulting nonlinear problem is solved computationally in an efficient manner. More importantly, computed PEM properties at different operating conditions, such as the specific conductivity and the electro-osmotic drag coefficient, compare favourably to values in the literature. In addition, the analysis reveals insights into the nonlinear couplings between transport processes and the structure of the elastic domain which motivates studies of other elastic, nanofluidic systems.

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