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Direct Numerical Simulations of Concentration and Temperature Polarization in Direct Contact Membrane Distillation[1] JINCHENG LOU, NILS TILTON, Colorado School of Mines — Membrane distillation (MD) is a method of desalination with boundary layers that are challenging to simulate. MD is a thermal process in which warm feed and cool distilled water flow on opposite sides of a hydrophobic membrane. The temperature difference causes water to evaporate from the feed, travel through the membrane, and condense in the distillate. Two challenges to MD are temperature and concentration polarization. Temperature polarization represents a reduction in the transmembrane temperature difference due to heat transfer through the membrane. Concentration polarization describes the accumulation of solutes near the membrane. These phenomena reduce filtration and lead to membrane fouling. They are difficult to simulate due to the coupling between the velocity, temperature, and concentration fields on the membrane. Unsteady regimes are particularly challenging because noise at the outlets can pollute the near-membrane flow fields. We present the development of a finite-volume method for the simulation of fluid flow, heat, and mass transport in MD systems. Using the method, we perform a parametric study of the polarization boundary layers, and show that the concentration boundary layer shows self-similar behavior that satisfies power laws for the downstream growth.

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