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Three-dimensional modeling of the thermoelectric MHD problem of the LIMIT liquid lithium divertor for fusion devices DAVIDE CURRELI, WENYU XU, KYLE LINDQUIST, DANIEL ANDRUCZYK, DAVID N. RUZIC, University of Illinois at Urbana Champaign — Flowing liquid lithium is a promising technique for the continuous heat removal from plasma-facing components in fusion devices. In ITER-like conditions, the divertor has to handle stationary fluxes of the order 10 MW/m^2; heat fluxes even bigger occur during H-mode-related instabilities and disruptions. The Lithium-Metal Infused Trenches (LIMIT) concept, proposed at University of Illinois, offers a viable and self-adaptive solution, thanks to the use of a thermoelectric MHD drive of liquid lithium inside elongated metal trenches. We present a 3D finite-element-based model for the solution of the TEMHD. The continuity of mass, momentum, energy and current are solved together with the generalized constitutive laws of thermoelectricity. The numerical results show that TE currents are generated at the interface between the two metals; under the action of the toroidal magnetic field, the resulting JxB force pushes the liquid lithium along the channels. The force acts mainly at the interface, where the Hartmann and the fluid boundary layers are present, developing early turbulence and fluid bi-shaped macrostructures on the velocity field. The stability of the method is discussed, together with further developments toward turbulent average of the convective noise.

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