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Modeling fluid flow and heat transfer in PEM fuel cell using lattice Boltzmann approach BEHNAM AFSHARPOYA, LIAN-PING WANG, University of Delaware — The fluid flow and species transport in fuel cells are affected by diffusion, advection, thermal gradients, material properties, electrochemical effects, and interfacial forces. A consistent approach capable of modeling these processes has not yet been developed. There have been studies addressing transport of reactants and products in the gas phase, however, water management and convective / thermal effects are still poorly understood. While most modeling efforts in fuel-cell research adopt the traditional CFD approach based on the continuum governing equations, we are developing lattice- Boltzmann (LB) methods to model fluid and thermal transport inside flow channels and gas diffusion layers in proton exchange membrane fuel cells. Specifically, we have developed and tested a new method for implementing structured non-uniform mesh using Lagrangian interpolations. A three-dimensional LB code has been developed for thermal flows through a section of serpentine channel with a gas diffusion layer. The gas diffusion layer is modelled as a porous medium using a modified LB equation and a forcing term. A separate distribution is used to model thermal effects. Methods of validating the approach and preliminary results will be presented.

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