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Numerical Simulation of Capillary Channels Growth in Heterogeneous Porous Anode in Aluminum Electrolysis Cells by Lattice Boltzmann Method MOUHAMADOU DIOP, MORAN WANG, Dept of Engineering Mechanics, School of Aerospace Center for Nano and Micro Mechanics Tsinghua University, Beijing 100084, China — This paper presents results obtained from three-dimensional numerical simulations of multiphase reactive flows in porous anode block in aluminum cells controlling a great extent of mass, heat and chemical balance in the anode-cathode region. A lattice Boltzmann method based on thermal reactive multiphase flows, is developed to simulate the spatial and temporal distribution of fluids, the effects of gas rate and capillary instabilities in the cryolite. A new model, which involves eighteen lattice particles for the first and second derivative, is proposed to achieve accurate simulations at high fluid density ratio. The effects of the dissolution of gas and the capillary number on the flow field induced by gas bubbles evolution are investigated. It is found that capillary channels in the limit of small Stefan, the radial transport of reactant out of the capillary channel decay exponentially with the height of penetration in the porous anode. Several examples are solved by the proposed method to demonstrate the accuracy and robustness of the method.

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