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Bubble Growth and Dynamics in a Strongly Superheated Electrolyte within a Solid-State Nanopore[1] EDLYN LEVINE, GAKU NAGASHIMA, School of Engineering & Applied Sciences, Harvard University, MICHAEL BURNS, The Rowland Institute at Harvard, Harvard University, JENE GOLOVCHENKO, Dept. of Physics and School of Engineering & Applied Sciences, Harvard University — Extreme localized superheating and homogeneous vapor bubble nucleation have recently been demonstrated in a single nanopore in thin, solid state membranes. Aqueous electrolytic solution within the pore is superheated to well above its boiling point by Joule heating from ionic current driven through the pore. Continued heating of the metastable liquid leads to nucleation of a vapor bubble in the pore followed by explosive growth. Here we report on the growth dynamics of the vapor bubble after nucleation in the strongly superheated liquid. The process is modeled by numerically solving the Rayleigh-Plesset equation coupled with energy conservation and a Stefan boundary condition. The initial temperature distribution, peaked at the pore center, is taken to be radially symmetric. Energy conservation includes a Joule heating source term dependent on the bubble radius, which grows to constrict ionic current through the nanopore. Temperature-dependent properties of the electrolyte and the vapor are incorporated in the calculation. Comparison of the model to experimental results shows an initial bubble growth velocity of 50m/s and total bubble lifetime of 16ns.

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