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Finite Element Modeling of Current-Induced Filaments in Nanocrystalline Silicon SEAN FISCHER, CHRISTIAN OSORIO, NICHOLAS WILLIAMS, HELENA SILVA, ALI GOKIRMAK, University of Connecticut — Rapid, heat induced phase transitions in a mixed phase semiconductor may lead to current percolation along a highly conductive preferred path, or filament. In this study, we use 2-D, finite element simulations to model the time dependent evolution of current-induced filaments in nanocrystalline silicon (nc-Si) wires. Nc-Si wires are modeled as isolated crystalline silicon (c-Si) circles randomly distributed in an amorphous silicon (a-Si) wire 500 nm in length and 75 nm in width. Simulations include temperature dependent material parameters for electrical conductivity, thermal conductivity, heat capacity, and account for latent heat of fusion during phase transition from solid to liquid silicon. Field dependent material parameters are neglected to improve simulation convergence. Voltage pulses of amplitude 300 V and rise time less than 1 ns produce molten filaments $\sim$ 5 nm in width extending the length of the wire. The resistance of each wire decreases by four orders of magnitude during formation and filament current density exceeds 500 MA/cm^2.

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