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Modeling Electrode Plasma Effects in Particle-in-Cell Simulation of High Power Devices[1] TIMOTHY POINTON, Sandia National Laboratories — A new method for including electrode plasma effects in particle-in-cell simulation of high power devices is presented. It is not possible to resolve the plasma Debye length, $\lambda_D \sim 1\ \mu$m, but using an explicit, second-order, energy-conserving particle pusher avoids numerical heating at large Δx/λ_D >> 1. Non-physical plasma oscillations are mitigated with Coulomb collisions and a damped particle pusher. A series of 1-D simulations show how plasma expansion varies with cell size. This reveals another important scale length,$\lambda_E = T/(eE)$, where E is the normal electric field in the first vacuum cell in front of the plasma, and T is the plasma temperature. For Δx/λ_E < ~1, smooth, physical plasma expansion is observed. However, if Δx/λ_E >> 1, the plasma "expands" in abrupt steps, driven by a numerical instability. For parameters of interest, λ_E << 100 μm. It is not feasible to use cell sizes small enough to avoid this instability in large 3-D simulations.

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