Abstracts

Device-level simulation of wave propagation along metal-insulator-semiconductor interconnects

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A device-level simulation is presented for studying wave propagation along metal-insulator-semiconductor interconnects. A set of nonlinear equations is first formulated by combining the motion equations of charged carriers and Maxwell's equations. The set of nonlinear equations is then transformed into the frequency domain, which leads to sets of nonlinear equations for the fundamental mode and its harmonics. Finally, the sets of nonlinear equations in the frequency domain are discretized using the finite-element method and solved using Newton's iterations. Special numerical enhancements are implemented to speed up the computational convergence and handle the boundary layer nature of the problem under study. This device-level simulation provides knowledge on field-carrier interactions, semiconductor substrate loss, and nonlinearity, as well as slow-wave and screening effects of charged carriers. This device-level simulation scheme enables a rigorous full-wave study of nonlinearity effects that arise from semiconductor substrates. Numerical examples for some practical material and geometrical parameters are included to illustrate capabilities and efficiency of the proposed device-level simulation scheme.

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