Nanoscale Heat Transport Model For Microelectronic Device Design

Albert Beardo[1]

[1]Universitat Autònoma de Barcelona, Barcelona, Spain

Abstract

Heat management has became a bottleneck in electronic engineering because of the large amount of energy released by current devices due to its extreme level of miniaturization [1]. This is a very important limitation to achieve, for example, terahertz clock-rates in computing and it is related to the limited success in obtaining high-performance thermoelectric devices.

We present the COMSOL Multiphysics® implementation of the hydrodynamic heat transport equation (generalization of Fourier law) with ab initio calculated parameters along with the appropriate boundary condition for free surfaces and interfaces. The model allow to predict the thermal response of nanoscale semiconductor complex structures in stationary [2,3] and transient [4] situations. The model predicts the emergence of memory and non-local effects in heat transport at reduced length and time scales [5], providing the required insight to develop new designs to optimize heat dissipation and to manage heat in electronic engineering.

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