Modeling Internal Heating of Optoelectronic Devices Using COMSOL

Nathan Brunner[1]

[1]Voxtel, Inc, Beaverton, OR, USA; University of Oregon, Eugene, OR, USA

Abstract

While biased and under illumination, semiconductor devices generate heat internally due to inefficiencies in absorption and Joule heating - heating due to resistance and current flow. Excessive heating in certain areas or under certain conditions may cause failure in the device due to compromising dielectric material, melting/migrating metal contacts, or even dopant migration, rendering the device useless. It is of particular interest in this process to model the resistivity of the device, as it changes with charge carriers. This paper looks to expand he realm of public knowledge about semiconductor modeling in COMSOL as related to specific interfacing with the software, whereas previous publications have placed a majority of discussion on theory. A 2-d model of devices will be used to model heat transfer in solids employing maps of resistivity (figure 1), light absorption, and forced current to calculate heating within the device (figure 2). Different devices will be explored, ranging from a basic p-n junction to more complex heterojunction devices, with emphasis on the compounds InGaAs and InAlAs.

Figures used in the abstract

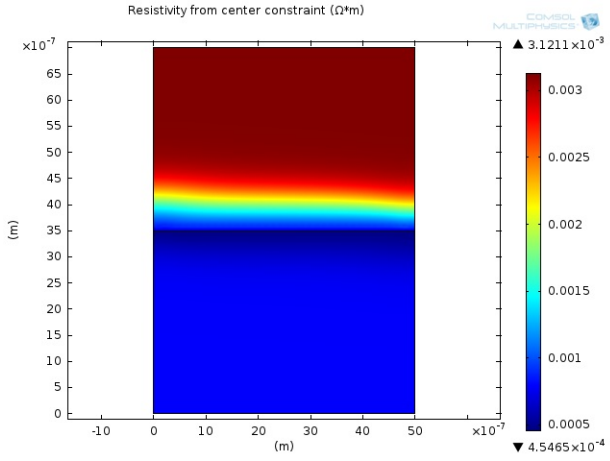

Figure 1: P-n junction resistivity based on charge carrier position, from solved transport equations.

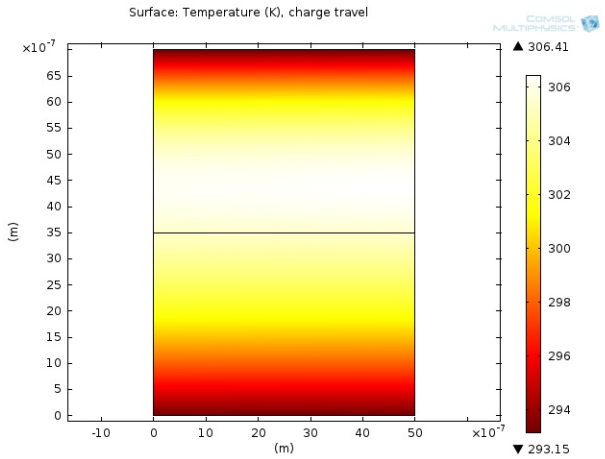

Figure 2: Final temperature. Joule heating from resistivity in combination with 10mA forced current and charge carrier movement.