SILICON CARBIDE AS A PHOTOCONDUCTIVE SWITCH MATERIAL FOR HIGH POWER APPLICATIONS

Kapil S. Kelkar

Dr. Naz Islam, Dissertation Supervisor

ABSTRACT

This research work discusses the effort at the Electrical and computer engineering (ECE) department at the University of Missouri Columbia (UMC) in developing this technology through simulation and experiments with SiC material. Specifically, the rationale for employing extrinsic photo-conductivity, the role of compensation mechanisms have been demonstrated, modeled, and analyzed. The device material fabrication methods and package structures developed to date are discussed. The behavior and the response of the two compensated structures have been discussed in terms of recombination time and optical sensitivity. Material characterization showing agreement with the experimental results was based on choosing the right parameters on trap levels and compensation mechanisms. The experimental switching results with both intrinsic and compensated SiC photo switches using sub-bandgap photon energy for code calibration and high power PCSS analysis is presented and compared with semiconductor physics models. The methods used to determine the density and recombination cross section of interband dopants is also presented. A method to improve the hold off voltage of the PCSS by many orders of magnitude is proposed. Laser illumination data with the improved design is also presented.