Notice and Invitation

Oral Defense of Doctoral Dissertation

The Volgenau School of Engineering, George Mason University

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Gallium Oxide Metal Oxide Semiconductor Field Effect Transistor Analytical Modeling and Power Transistor Design Trades

Monday, 30 October 2017, 2:30 pm (1430)

ENGR 3507

All are invited to attend.

Committee

Dr. Nathalia Peixoto, Chair

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Abstract

Gallium oxide has recently emerged as a promising semiconductor material for high voltage switch applications owing to its ultra-wide band gap of ~4.8 eV and the corresponding expected critical field strength of ~8MV/cm. β-Ga_2O_3, which is the most stable polymorph, also has the advantage of melt grown, defect free, large diameter native substrates which are traditionally much more cost effective than vapor phase substrates such as those for incumbent power switching materials like gallium nitride and silicon carbide. Using these substrates, researchers have already developed high quality homoepitaxial channel layers with n-type doping concentrations ranging from 10^{16} to $>10^{20}$ cm^{-3} using group IV materials as dopants. Further, several groups have fabricated metal semiconductor and metal oxide semiconductor field effect transistors (MESFET and MOSFET) using these channel layers with excellent current control and high breakdown voltages.

In this work, we utilize silicon MOSFET theory to develop a simple analytical model for the state-of-the-art depletion mode β-Ga_2O_3 MOSFET. The model is verified for devices with varying doping concentration and channel thickness and is also investigated for gate oxide changes and operating temperature. Implications for device development toward low loss power switches and radio frequency (RF) devices are provided using the model formulation. Limitations of the simple model and potential future additions toward a comprehensive compact model as the gallium oxide material system matures are also investigated. Finally, future β-Ga_2O_3 device developments are anticipated, and it is shown how the model can be used to expedite the development of these devices.