Process Sensing and Simulation for GaN-based Semiconductor Electronics

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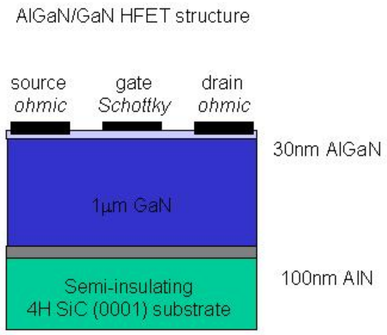
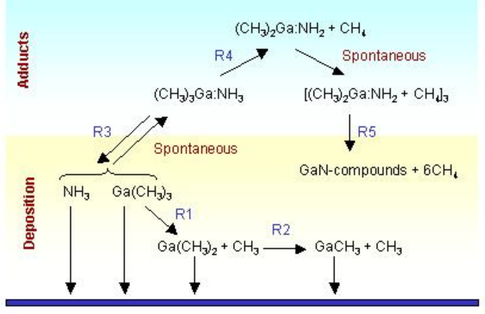
BACKGROUND

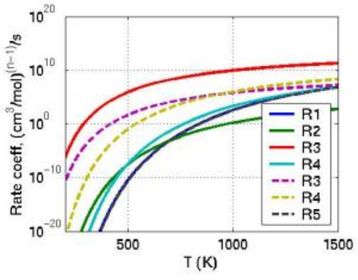
GaN electronic devices have great potential for high-frequency, high temperature, high power density applications, such as radar electronics



THE CHALLENGE

Growth of GaN epitaxial films and GaN-based alloys with uniformity and quality constraints that are much higher relative to optoelectronic applications





PROJECT IMPACT

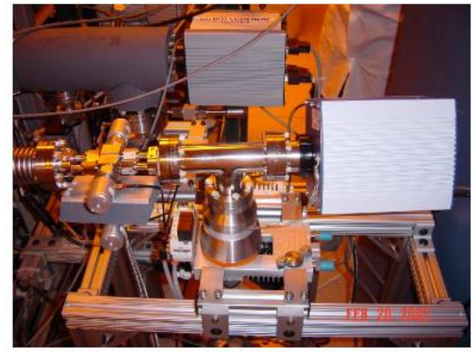
Process sensing, simulation, and control solutions applicable to other semiconductor devices fabrication processes

APPROACH

Joint research program initiated in Fall, 2001 and continuing through 2002 between Northrop Grumman and the University of Maryland

Sensing

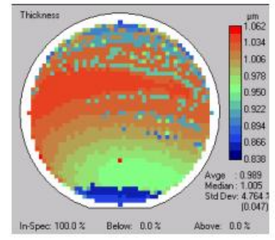
Phase 1: In-situ real-time sensing of the GaN MOCVD using downstream mass spectrometry
Phase 2: Synchronized capture of the equipment state signals in time with chemical sensor information
Phase 3: Sensor implementation for manufacturing process control



Simulation

Phase 1: Characterization of the GaN process to determine which chemical and transport processes are critical
Phase 2: Gas-phase transport modeling to evaluate reactor design alternatives and interpret sensor signals
Phase 3: Model-based process optimization/design

CVD process operations leading to spatially nonuniform film growth



Object-oriented CVD simulation tools for diagnosing factors responsible for nonuniformity

Simulation-based process recipe optimization; assessment of design alternatives