**Reaction Kinetics and Transport Model for Gallium Nitride MOVPE Reactor Showerhead Design**

Rinku P. Parikh, Raymond A. Adomaitis, Brendan D. Hoffman, Michael E. Aumer, Deborah Partlow, Darren Thomson

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**MOTIVATION**

Gallium Nitride (GaN) is a compound semiconductor material with tremendous potential in the electronics industry. Metalorganic vapor phase epitaxy (MOVPE) is the principal method used to grow thin films of this material. Therefore, fundamental understanding of complex gas phase and surface reactions combined with flow, heat transfer, and mass transfer processes is critical for the production of high quality deposited layers.

**Applications of GaN based Materials**

- Aerospace devices that can function over a wide temperature range and remain unaffected by radiation.
- Powerful new radar technology which will detect smaller and faster targets.
- A blue laser that will increase the storage capacity of a compact disc.

**CHEMICAL KINETICS**

The growth of quality GaN thin films is complicated by complex gas phase reactions between the common precursors: trimethylgallium (TMG) and ammonia (NH₃). Two competing reaction pathways exist which lead to either adduct formation or pyrolysis of TMG.

**MODEL DEVELOPMENT**

**Goal:** Develop a model that captures mass transfer and kinetic effects (gas phase and surface reaction) inside showerhead.

**Problem:** Adduct formation and deposition within the showerhead can contribute to poor growth rate and film quality.

**SUMMARY & FUTURE WORK**

- **Summary**
  - Object oriented techniques create an efficient approach to assembling models of this form, and allow the addition of more model components without much difficulty.
  - Developed a model that describes mass transport and kinetic effects within the showerhead.

- **Future Work**
  - Examine kinetic theory of gases: bimolecular collision rate vs. impingement rate of molecules on a surface.