OPTIMIZATION OF THE CHEMICAL VAPOR DEPOSITION PROCESS FOR GALLIUM NITRIDE IN A VERTICAL ROTATING DISK REACTOR

Pradeep George[1] Jiandong Meng[2] Yogesh Jaluria[2]

[1]Division of Engineering, New York University Abu Dhabi, UAE
Email: pg66@nyu.edu

[2]Department of Mechanical and Aerospace Engineering
Rutgers, The State University of New Jersey
Piscataway, NJ 08854, USA

Abstract

This paper considers the simulation and optimization of the Metalorganic chemical vapor deposition (MOCVD) process for the deposition of Gallium Nitride (GaN) film from the precursors, Trimethylgallium (TMGa) and ammonia (NH_3), carried by hydrogen (H_2) in a vertical rotating-disk Sandia reactor. The focus of the study is on the average deposition rate. The level of quality needed depends on the intended application, with electronic and optical materials imposing the most stringent demands. Large area film thickness and composition uniformity are achieved by proper control of the governing transport processes. The focus is on optimizing the system and the transport processes, including chemical reactions and mass transfer that govern the deposition. The paper is composed of three parts. The first part is the simulation. Initially, the thin film deposition process is simulated using the Computational Fluid Dynamics (CFD) code, ANSYS FLUENT. The CFD model has 17 gas phase and 23 surface species participating in 17 gas phase and 52 surface reactions. These numerical simulations are used to determine the effects of important design parameters and operating conditions on the deposition rate. Design variables which have a significant effect on the deposition rate and uniformity of the deposited film are identified. Response surface for average deposition rate as a function of these design variables are generated. Compromise response surface method (CRSM) is used for the generation of the response surface. In the final part, the response surface is used to optimize the average deposition rate.