AN ABSTRACT OF A THESIS

AN ENGINEERING ANALYSIS OF BORON DOPING PROCESS IN A THERMAL DIFFUSION FURNACE

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Master Of Science in Chemical Engineering

This thesis presented models for simulating the various physico-chemical phenomena occurring in a hydrogen injection diffusion furnace process for the doping of silicon wafers using boron nitride (BN) solid sources. A generalized model accommodating practical diffusion furnace geometries and including the formation of metaboric acid, metaboric acid trimer, and boric acid and their subsequent dispersion in the diffusion furnace was presented. The deposition model for the consumption of the borate species at the silicon wafer surface to form borosilicate glass film was also presented. Reversible chemical reactions were assumed at the BN and the silicon wafer surfaces. Composition profiles of water vapor and the borate species were calculated as a function of axial and radial positions and time. Reaction rate profiles and thickness of borosilicate glass film as a function of wafer radius, radial position, and time were also calculated.

The result of this work is a comprehensive model that simulates the diffusion furnace as a system including the entrance volume, the annular and axial space around the wafer stack, radial spaces between wafer/source pairs, and the exit chamber. The model has been calibrated using experimental data. The model may be employed for sensitivity analysis and predictions for different process parameters.

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