Department of Electrical and Computer Engineering
North South University

Senior Design Project

VOIDS IN PHASE CHANGE MEMORY NANODEVICES

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Faculty Advisor:
Dr. Nafisa Noor
Assistant Professor
ECE Department

Spring, 2023

LETTER OF TRANSMITTAL

June, 2023

To

Dr. Rajesh Palit
Chairman,
Department of Electrical and Computer Engineering
North South University, Dhaka

Subject: **Submission of Capstone Project Report on "Voids in Phase Change Memory Nanodevices"**

Dear Sir,

With due respect, we would like to submit our **Capstone Project Report** on **"**Voids in Phase Change Memory Nanodevices**"** as a part of our BSc program. The report deals with Emerging Memory Technology. This project was very much valuable to us as it helped us gain insight about the material physics associated with Phase Change Memory. We tried to the maximum competence to meet all the dimensions required from this report.

We will be highly obliged if you kindly receive this report and provide your valuable judgment. It would be our immense pleasure if you find this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours,

....
Zahin Tazwar
ECE Department
North South University, Bangladesh

....
Musfiq Ahmed
ECE Department
North South University, Bangladesh

....
Toufiq Mohammad Hassan
ECE Department
North South University, Bangladesh

APPROVAL

Zahin Tazwar (1921486643), Musfiq Ahmed (1921162643) and Toufiq Mohammad Hassan (2022329643) from Electrical and Computer Engineering Department of North South University, have worked on the Senior Design Project titled "Voids in Phase Change Memory Nanodevices" under the supervision of Dr. Nafisa Noor partial fulfillment of the requirement for the degree of Bachelors of Science in Engineering and has been accepted as satisfactory.

Supervisor's Signature

……………………………………..

Dr. Nafisa Noor
Assistant Professor
Department of Electrical and Computer Engineering
North South University
Dhaka, Bangladesh.

Chairman's Signature

……………………………………..

Dr. Rajesh Palit
Professor
Department of Electrical and Computer Engineering
North South University
Dhaka, Bangladesh.

DECLARATION

This is to declare that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. All project related information will remain confidential and shall not be disclosed without the formal consent of the project supervisor. Relevant previous works presented in this report have been properly acknowledged and cited. The plagiarism policy, as stated by the supervisor, has been maintained.

Students' names & Signatures

1. Zahin Tazwar

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2. Musfiq Ahmed

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3. Toufiq Mohammad Hassan

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ABSTRACT

Voids in Phase Change Memory Nanodevices

An experimental and Finite Element Model (FEM) approach has been taken in this study to predict and model the formation of voids in melt-quenched or as-deposited amorphous Ge2Sb2Te5 and Silicon during annealing. This study includes the thermal models that account for laser heating of the nanostructures during device production, as well as the void generation with crystal nucleation and growth. Furthermore, the framework is put through various sets of simulations involving set/reset operations, set/reset cycles, in a mushroom cell with temperature and crystallinity dependent parameters for Ge2Sb2Te5. The contrast in resistance due to void formation is analyzed both mathematically and also in simulation using Si nanostructure. Finally, various aspects of impacts and sustainability is reflected at the end of this report.