Three-Level Physics Guided Stochastic Modeling of Nanostructure Variations in Nanomaterial Manufacturing Processes

Introduction

•In the past few years, progress in electronic devices has been driven by scaling transistors to ever-smaller dimensions motivating the search for new device concepts and new materials.

•A ***grand challenge*** encountered with manufacture of these nanomaterials is related to nano process repeatability as exhibited by variations in nanostructures or nano morphologies which directly impact nano device functional performance.

•The ***goal*** of this project is to establish a cost-effective modeling methodology for predicting and monitoring the variations in nanomanufacturing processes.

Hypotheses & Methods

•Hypothesis 1: Commonality between similar-but-non-identical nano processes can contribute to improvement variation modeling

•Hypothesis 2: Nano process physics (nanowire growth kinetics) can supplement additional information to limited nano process data for modeling improvement.

•A three-level physics guided stochastic modeling approach will be developed to cost-effectively predict nano process variations (Fig. 3).

Highlights of findings for future

•The proposed transfer learning method can significantly improve nanowire growth prediction given limited nano process data (Fig. 3b)

•Two papers under preparation

•Target funding:

- **National Science Foundation**. include Nanomanufacturing and SNM programs.
- **Department of Defense**. ONR and AFOSR
- Two NSF proposals were submitted

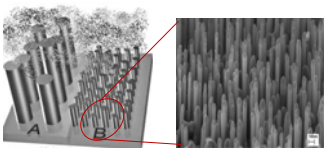


Fig. 1 Nanostructure variations in the nanowire produced for biosensors (Note the great variations of nanowire lengths)

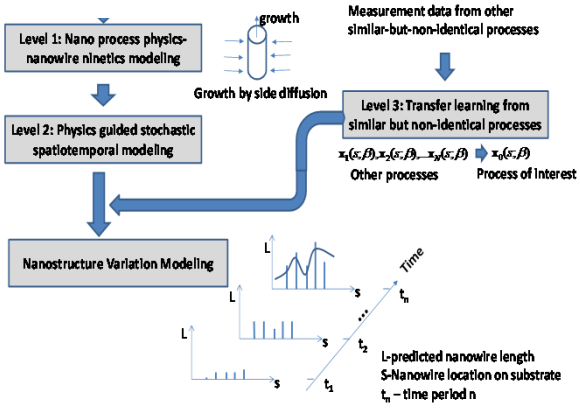


Fig. 2 A summary of the proposed modeling approach for nanostructure variations

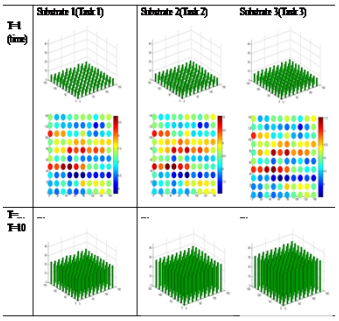


Fig. 3(a) Modeling results of nanowire growth

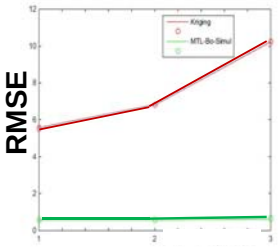
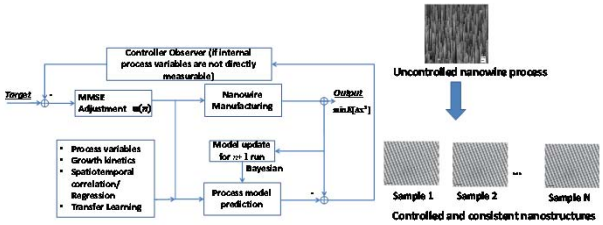


Fig. 3(b) Reduced model error

Red: Traditional method
Green: new method

Future Work

- Establishing a cost-effective quality control strategy for nanowire manufacturing
- Big data enabled intelligent nano processes



Hui Wang
Assistant Professor
Industrial and Manufacturing Engineering
Email: hwang10@fsu.edu Ph: 850-410-6387