

**Guelph-Waterloo Physics Institute
Ph.D. Thesis Defence**

Jun Shi

Date: Monday, March 1st, 2010

Time: 2:00 pm

Place: MacNaughton Room 222

Department of Physics

University of Guelph

THESIS TITLE:

**GROWTH, STRUCTURAL, AND ELECTRICAL CHARACTERIZATIONS OF
ORGANIC THIN FILM ON SI-BASED SUBSTRATES**

Abstract:

This PhD thesis focuses on the investigation of growth, structural and electrical properties of organic semiconductor thin films on Si-based substrates. With a novel design for a home-made Knudsen cell, growth of layer-by-layer organic thin films (tetracene and pentacene) has been successfully achieved under proper kinetic growth conditions using an ultra-high-vacuum organic molecular beam deposition (UHV-OMBD) system. Morphological studies and modern synchrotron radiation experimental results have shown that the growth is in a 2D+3D mode driven by the molecular structure conformation processes near the interfaces. Using the classic nucleation theory, the molecular nucleation behaviors (condensation, critical nucleus size, diffusion, activation energy) on Si-based surfaces have been analyzed to be kinetically diffusion-limited. In addition, using the dynamic scaling theory, the anomalous interface roughening processes of tetracene and pentacene thin film growth have been discovered and the growth parameters (e.g. roughness, dynamic, and growth exponents) extracted. A new view of “fractal-mound” -on- “fractal-mound” growth mode has been proposed to explain the exotic roughening behavior of organic thin film growth. Finally, the electrical transportation dependence on activation layer thickness in organic thin film transistors has been studied.

Chair: R. Wickham (*Physics*)

Advisor: X. R. Qin (*Physics*)

Advisory committee member: D. Sullivan (*Physics*)

Examination committee member: P. A. Rowntree (*Chemistry*)

External Examiner: Z. H. Lu (*University of Toronto, Materials Science*)