Ph.D. Defense
Scott Allen
DATE: Tuesday, January 19, 2010
TIME: 10:00 a.m.
PLACE: MacNaughton Room 222
University of Guelph

THESIS TITLE:
Quantitative Kinetics and Angle Scanning Surface Plasmon Resonance Imaging

ABSTRACT:

Surface plasmon resonance (SPR) has been used extensively to monitor the kinetics of the adsorption of molecules at surfaces. We have quantitatively evaluated the accuracy of three different methods for measuring the kinetics of the adsorption of molecules using SPR by modeling the SPR response for an isotropic optical multilayer system. The SPR kinetic methods included, the tracking of the minimum of the SPR reflected intensity and the tracking of the SPR reflected intensity at a fixed angle of incidence θ_i, as well as a third novel method, the tracking of the inflection point of the SPR reflected intensity. SPR minimum tracking and SPR inflection point tracking were found to yield quantitatively accurate measures of the time constant τ of the kinetics, whereas the accuracy of the τ values determined using SPR fixed angle reflectivity tracking was found to vary with the choice of fixed θ_i. A method was developed to deconvolute the SPR curve shape from the SPR fixed angle reflectivity data. The result of this deconvolution was a dramatic increase in the accuracy of the τ values.

The SPR kinetic method modeling results were validated by designing and constructing an automated angle scanning SPR imaging instrument. The instrument incorporated a novel method to remove two imaging artifacts, beam walking and image compression, that severely impact the ability to track regions of interest (ROIs) within the image as θ_i is varied. By using this novel method, we are able to define multiple ROIs for an arbitrary θ_i and correctly track these ROIs at all other θ_i. In agreement with our modeling results, we show experimentally that the accuracy of the τ values obtained from the SPR fixed angle reflectivity tracking method depends significantly on the choice of fixed θ_i, and that the accuracy of the τ values improves dramatically by deconvoluting the SPR curve shape from the SPR fixed angle reflectivity data. We have also used our SPR imaging instrument to study the enzymatic degradation of cellulose

fibers that have been heterogeneously distributed on a gold film coated with a thin layer of thioglucose.

EXAMINING COMMITTEE:

Chair: Dr. Paul Garrett
Advisors: Dr. John Dutcher, Dr. Jacek Lipkowski
Internal Examiner: Dr. Robert Wickham
External Examiner: Dr. Andreas Mandelis