Chapter 1

Introduction

In December 2017 and May 2018, I was asked to partake in Grazing-incidence small-angle scattering(GISAXS) experiments investigating the structure of thin films at The Cornell High Energy Synchrotron Source (CHESS). A thin film is a thin layer of polymer deposited onto a wafer, in this case a silicon wafer. The experiments were conducted with the aim of understanding the structure evolution of star-block polymers on a silicon wafer when exposed to vapour annealing. X-ray scattering reflectometry was used to study how the star-block polymers arranged themselves when the volume of the polymer increased. X-ray reflectometry gives the researcher a snapshot of the study at that point in time. These snapshots can be used to calculate the thickness of the polymer, but this can only be done post experiment and is time consuming.

This leads to the experimental method called Spectroscopic Reflectometry, and the meaning of these two words gives insight into the nature of the method. Spectroscopic is a study of the interaction between light and matter and reflectometry is the study of an object using reflected light. This experimental technique can be used to measure the thickness of a thin film. The idea of running the two experimental technique parallel at CHESS was to monitor the thin films in real time giving us the ability to explore different vapour annealing protocols and see how the structure changed during these. The thickness measurements done at CHESS using Spectroscopic Reflectometry were not successful since the software's thin film model and the reflectance data did not fit well. Since beam time is precious, this problem was not investigated during the GISAXS.

This thesis has two purposes, it is a study of the third party apparatus called NanoCalc XR made by the company Ocean Optics[Insert link] and an investigation into how the reflectance changes during swelling of [Insert which polymers].

The first purpose is important since the NanoCalc XR spectrometer and software

will be used to investigate the thin films and this thesis will serve as an introduction to the apparatus since the user manual for the spectrometer and software is lacking in an explanation of the theory behind the thin film modelling and fitting.

1.1 Research Question

1.2 Structure of this thesis