

Understanding the reflectance of homo-polymers and block co-polymers using White Light Spectroscopic Reflectometry

Ongoing Master Thesis

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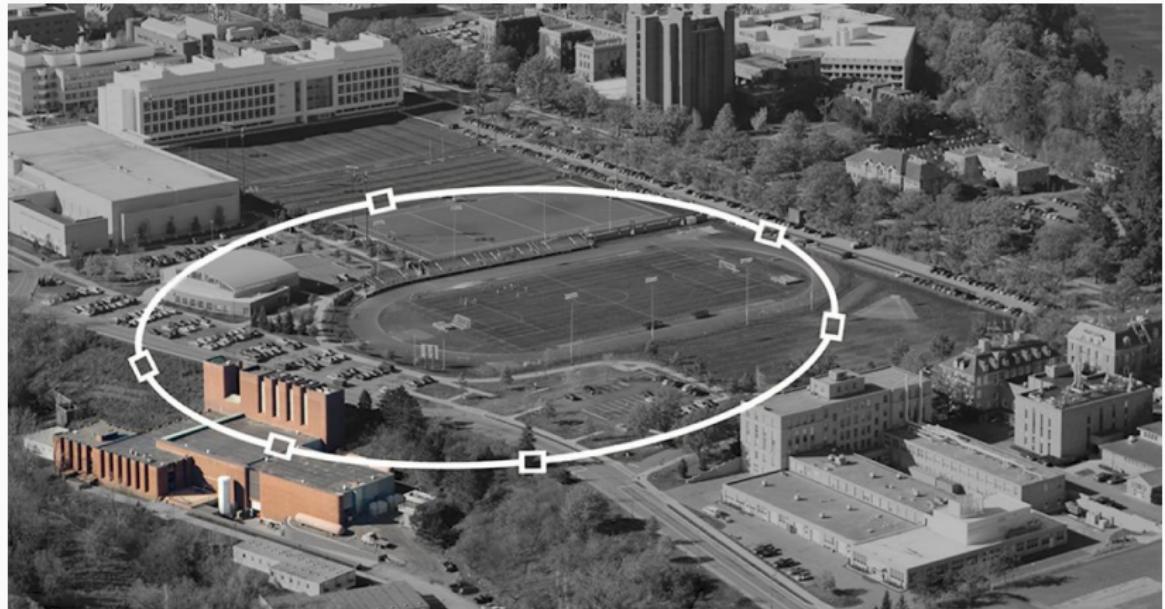
Master Thesis Background

Master Thesis Background

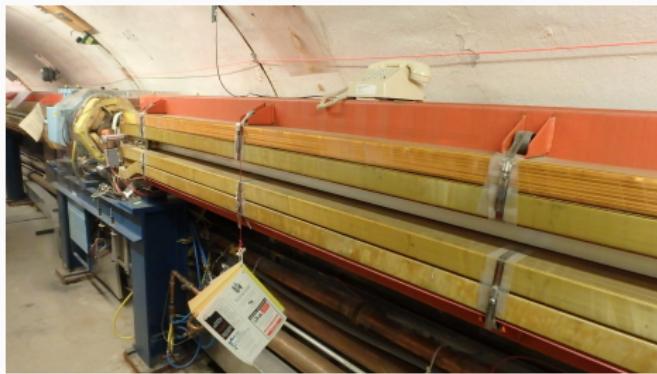
CHESS Dec 17 and May 18

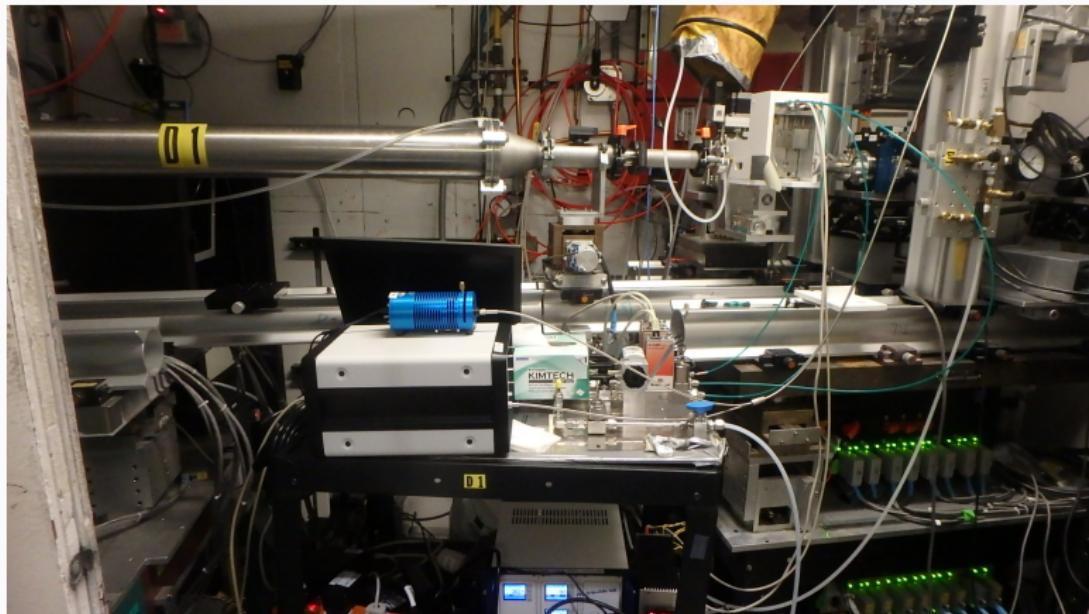


Cornell High Energy Synchrotron Source (CHESS)



Synchrotron Tunnel

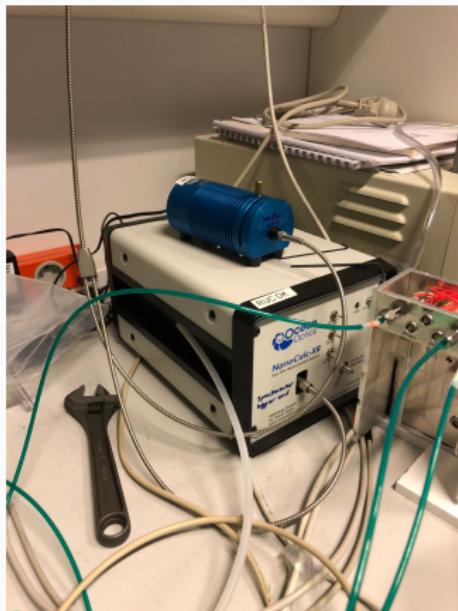
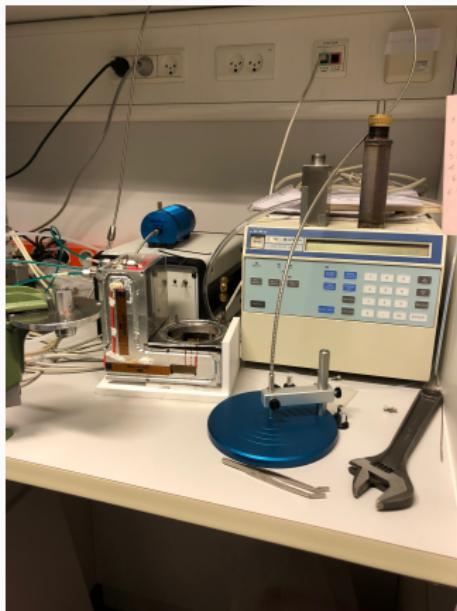




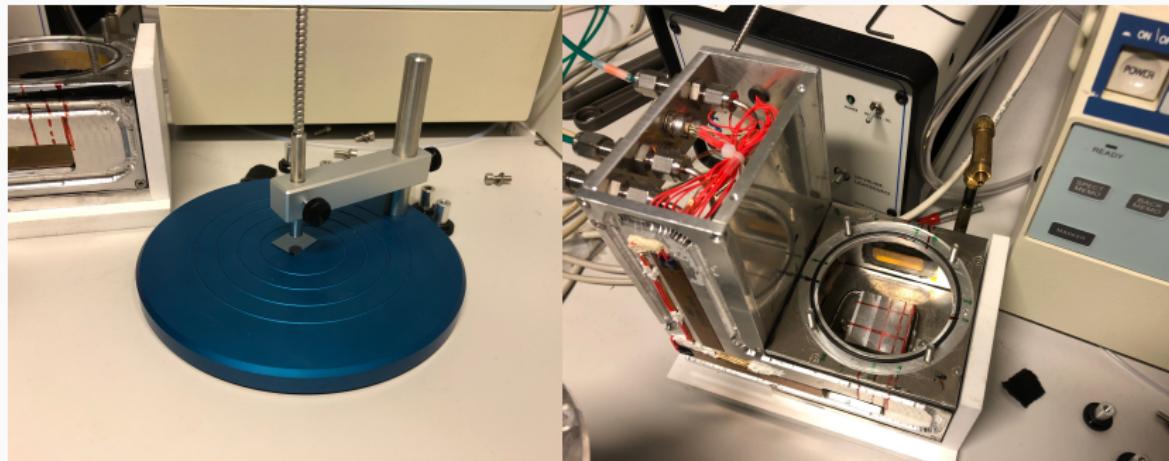
Experimental Setup

Components

NanoCalc XR, Halogen Light Source, Test Chamber and Single Point Stage



Components Cont.



Problem Formulation

Problem Formulation

What can White Light Spectroscopic Reflectometry infer with respect to SVA swelling experiments using the homopolymers: Polystyrene, Polyisoprene and Poly(methyl methacrylate)?

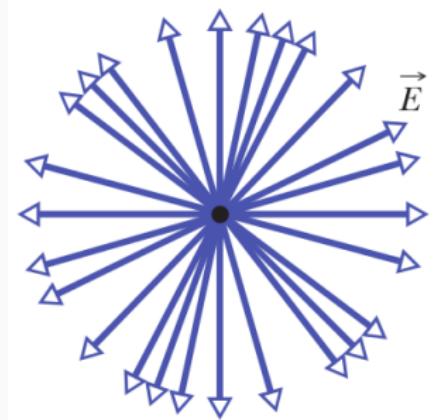
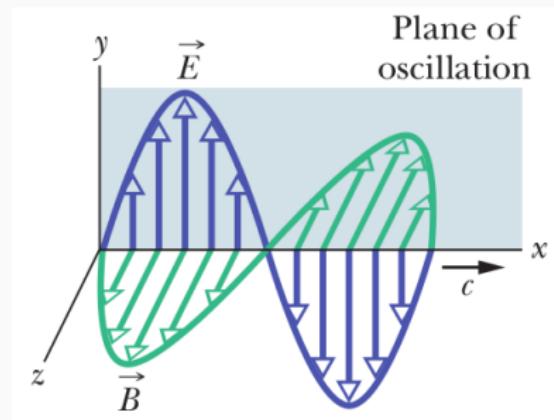
Can the same modelling of homopolymers be used with respect to Polystyrene-b-Polyisoprene?

Model:

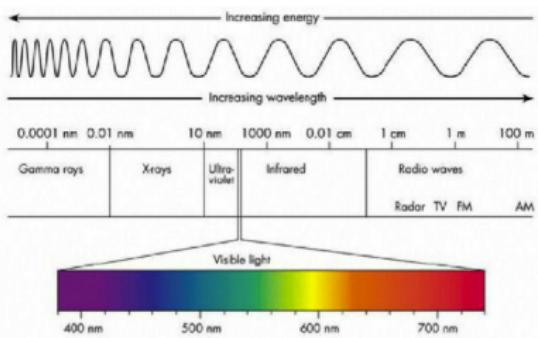
- Change in refractive index of the ambient
- Change in refractive index of the thinfilm
- In-situ thickness measurements

Light

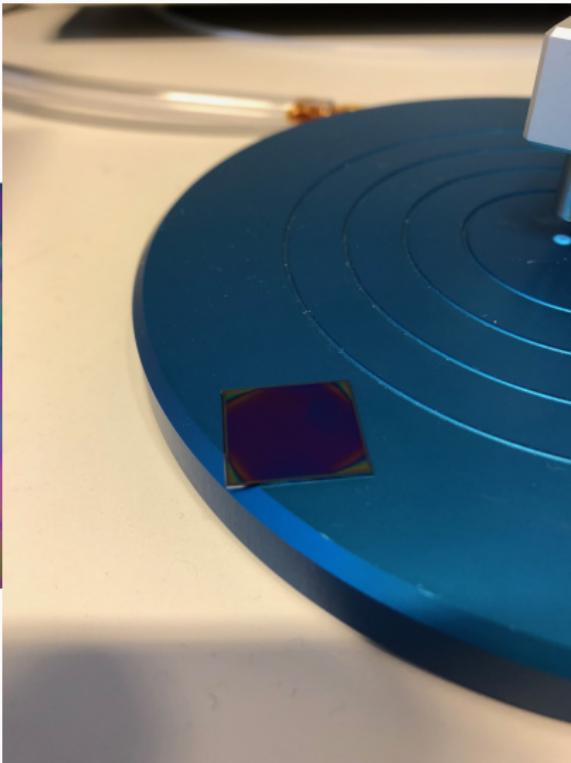
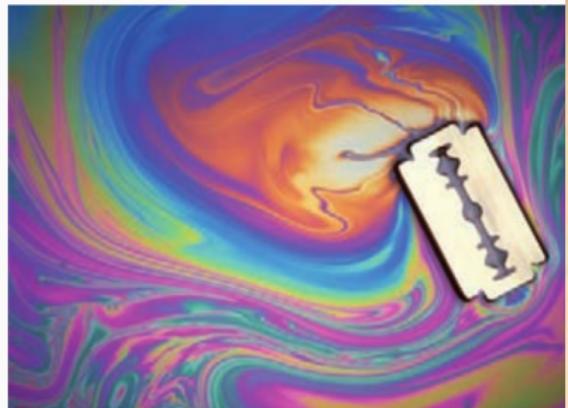
Electromagnetic Radiation



Light Spectrum and Spectrometer



Thin Film Phenomena

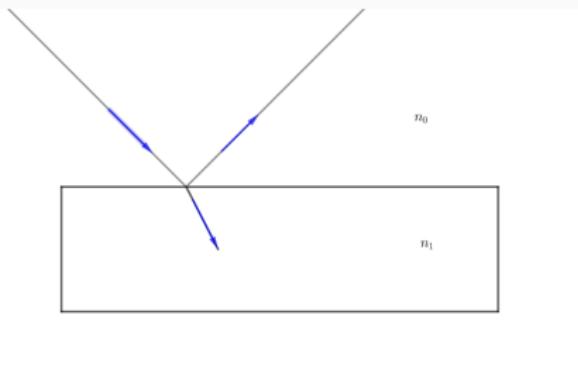


Preliminary Models

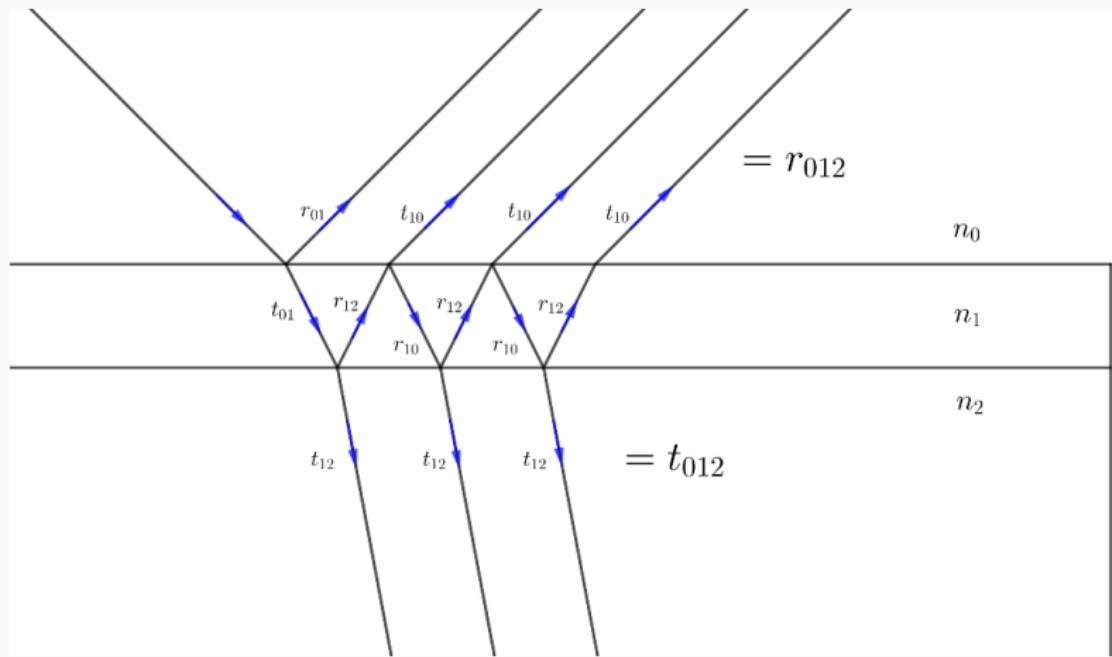
Fresnel Equations - Substrate

$$r_p = \frac{E_{r,p}}{E_{i,p}} = \frac{n_t \cos(\theta_i) - n_i \cos(\theta_t)}{n_i \cos(\theta_t) + n_t \cos(\theta_i)}$$

$$R_p = |r_p|^2$$



Fresnel Equations - One layer



$$r_{012} = r_{01} + t_{01} t_{10} r_{12} \exp(-i2\beta) + t_{01} t_{10} r_{10} r_{12}^2 \exp(-i4\beta) + \\ t_{01} t_{10} r_{10}^2 r_{12}^3 \exp(-i6\beta) + \dots$$

Fresnel Equations - One layer

$$r_{012} = \frac{r_{01} + r_{12} \exp(-i2\beta)}{1 + r_{01}r_{12} \exp(-i2\beta)}$$

$$\beta = \frac{2\pi d_1}{\lambda} n_1 \cos(\theta_1)$$

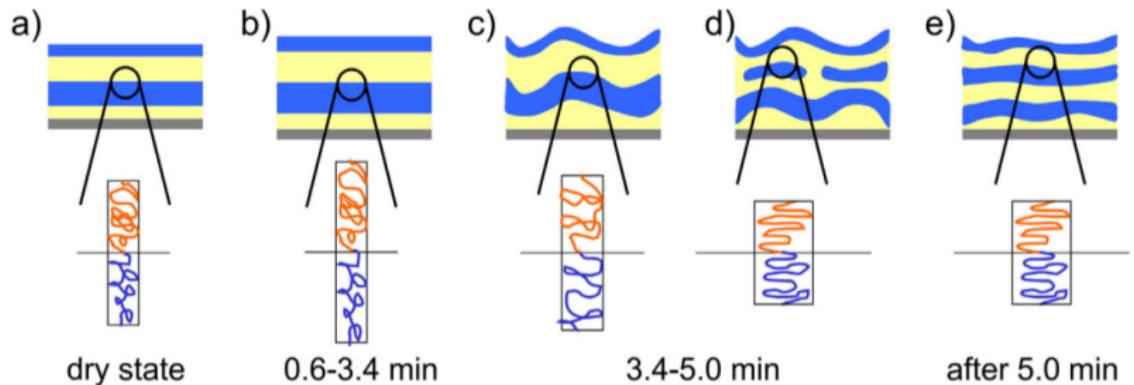
$$R_{012} = |r_{012}|^2$$

Results

Solvent Vapor Annealing of Polystyrene in Toluene

Why look at structure?

Structure in thinfilms



Structure in Nature

