TRiO RONALD E. McNAIR POST-BACCALAUREATE ACHIEVEMENT PROGRAM UCONN UNIVERSITY OF CONNECTICUT

Temperature-dependent Characterization of GST225 using Ellipsometry

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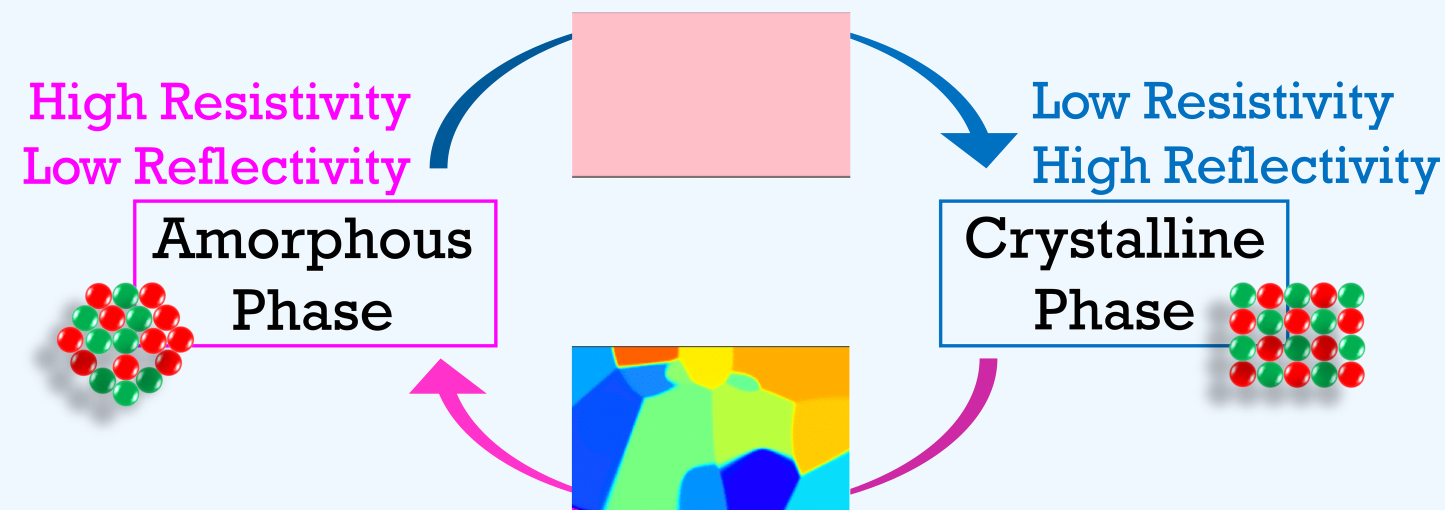
Project Aim

- Phase change materials (PCMs) have evoked attention as a potential fast, non-volatile memory device but are limited by their large power consumption.
- We aim to increase film density with increasing annealing temperatures and characterize the film at each temperature to increase device efficiency.

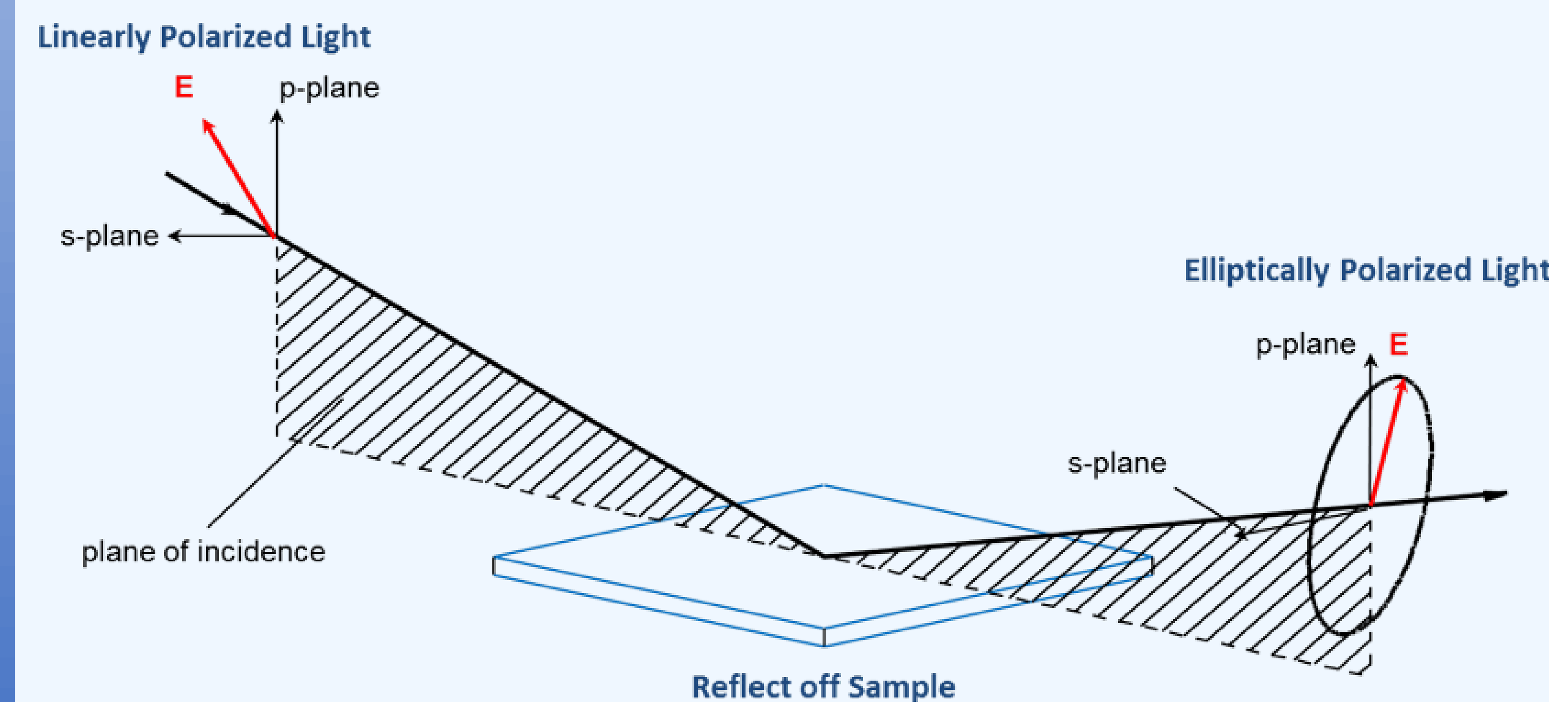
GST225

- $Ge_2Sb_2Te_5$, or GST225, is a PCM that can quickly transition between two discrete states through thermal excitation, allowing for memory to be stored

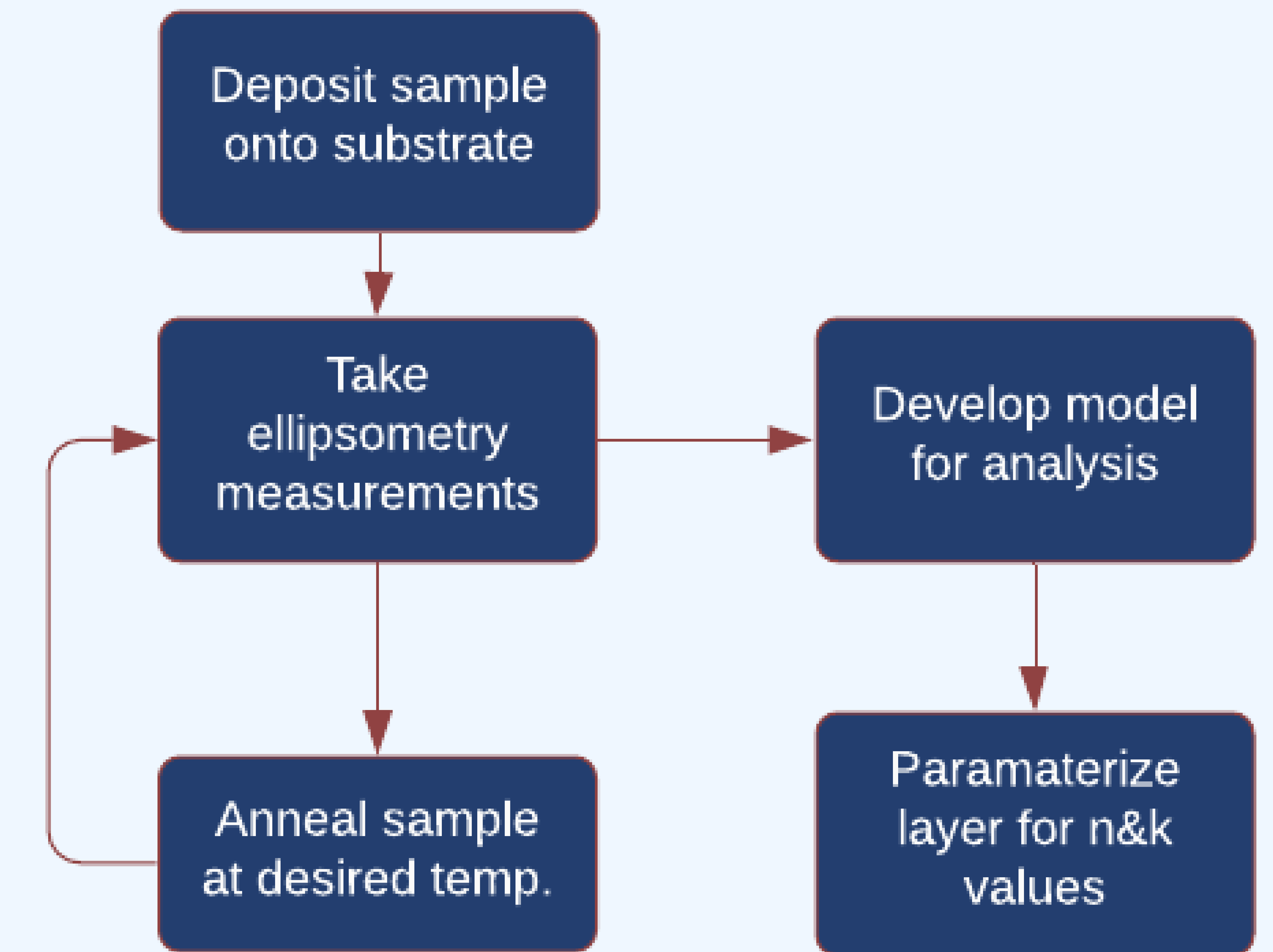


Ellipsometry Details

- Polarized light at multiple wavelengths is reflected off the sample, distorted, and measured by the receiver.
- A regression algorithm is used to fit established dispersion models, like the Tauc Lorentz model, to data points. This allows us to accurately estimate various physical characteristics of the film like thickness, optical bandgap, and surface roughness.



Methods



Results

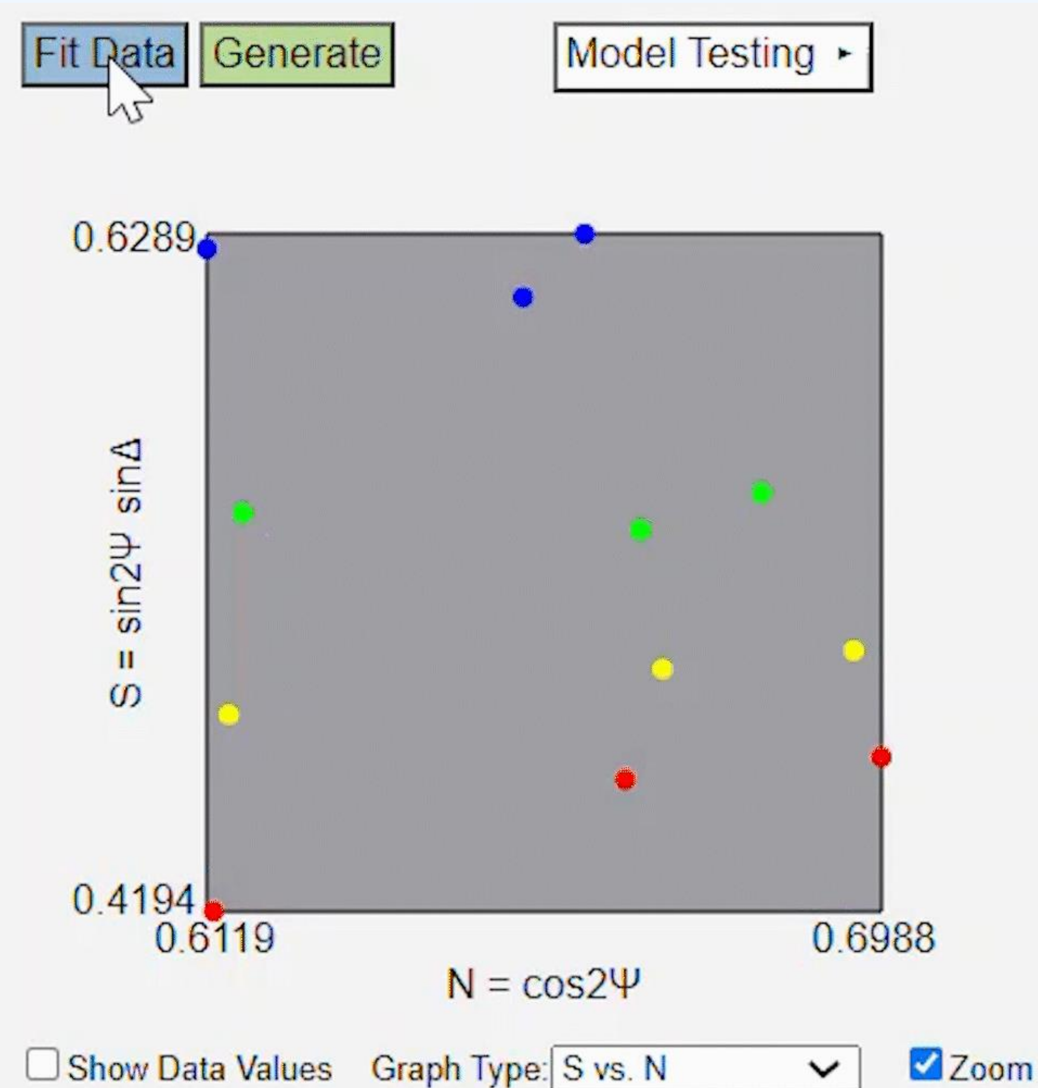


Figure 1. Animation of regression algorithm used for ellipsometry fits to measure samples

Uncapped GST225 Multi-Sample Analysis

Parameters	Annealing Temperature						
	50C	75C	100C	145C	150C	155C	160C
Fit Diff.	0.00183			0.0013			
Roughness (nm)	11.481	11.288	11.72	13.02	11.03	10.57	9.31
Thickness (nm)	52.767	52.485	53.767	47.64	48.84	48.54	45.6
Eg	0.59148	0.5983	0.53019	0.499	0.402	0.377	0.296

Figure 2. Ellipsometry data from both amorphous (50C – 100C) and crystalized samples (145C – 160C) analyzing roughness, thickness, and bandgap energy (Eg)

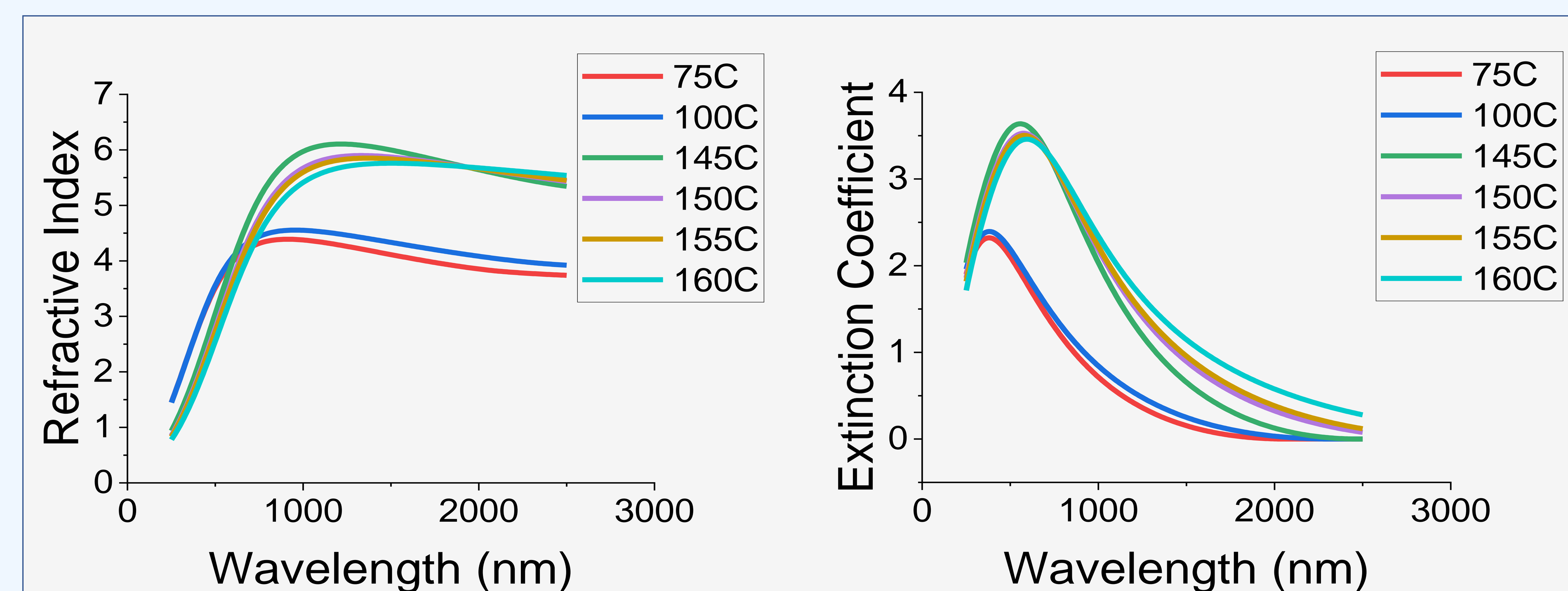


Figure 3. Refractive index and extinction coefficient of a 50nm GST225 film with respect to annealing temperature

Summary

- Ellipsometry analysis was perform on samples of GST225 to characterize various characteristics like surface roughness, thickness, optical bandgap, refractive index, and extinction coefficient.
- Preliminary results show good estimations of GST225 for both amorphous and crystalized sample from 50C to 160C

Future Goals

- Fabricate back-contact devices with shadow masks to allow for easier measurements
- Perform ellipsometry and resistivity measurements throughout for samples of various thickness up to 400C
- Conduct atomic force microscopy to characterize film roughness

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