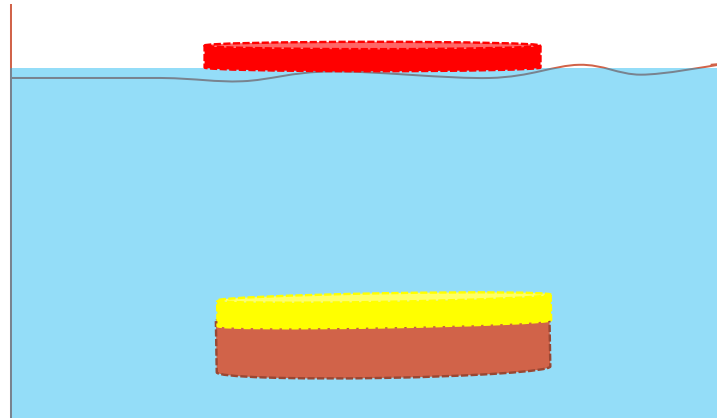


Interdiffusion in Thin Polymer Films

Carnegie
Mellon
University



Group3

Student presentation

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Tingting Liu

Lee Hoffman; Jonathan Doan; Matthew Bryan; Juntae Kim

Outline

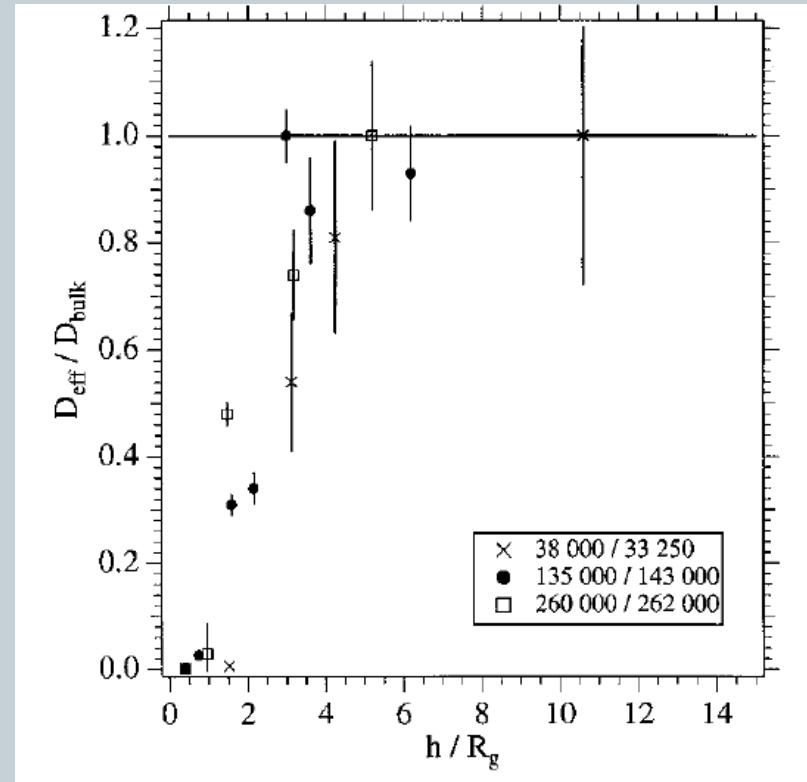


- Task
- Neutron Reflectivity
- Results
- Discussion
- Acknowledgement

Task



- Study inter-diffusion between (525 KDa) PS and d-PS thin films as a function of film thickness
- To determine the **effect of thickness** (confinement) on interdiffusion.
- To learn properly performing a reflectivity measurement for polymer thin films and **have fun**.



Lin E. et al. *Macromolecules* **1999**, 32, 3753-3757.

Samples



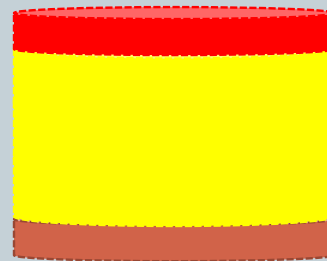
h-PS
d-PS



1Rg
1Rg



1Rg
2Rg



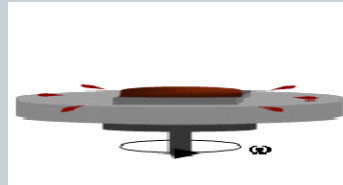
1Rg
4Rg

Sample Preparation

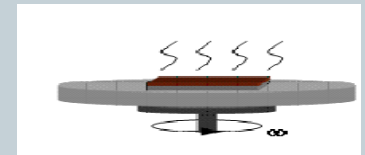


Dispense

1st layer Spin coating

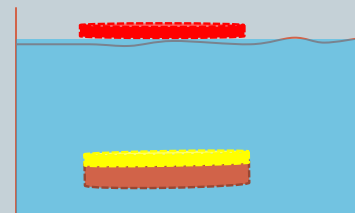
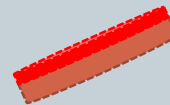
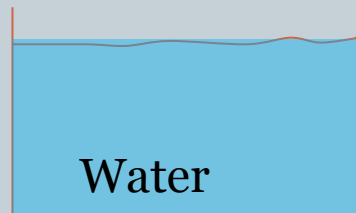


**Ramp-up
speeding**

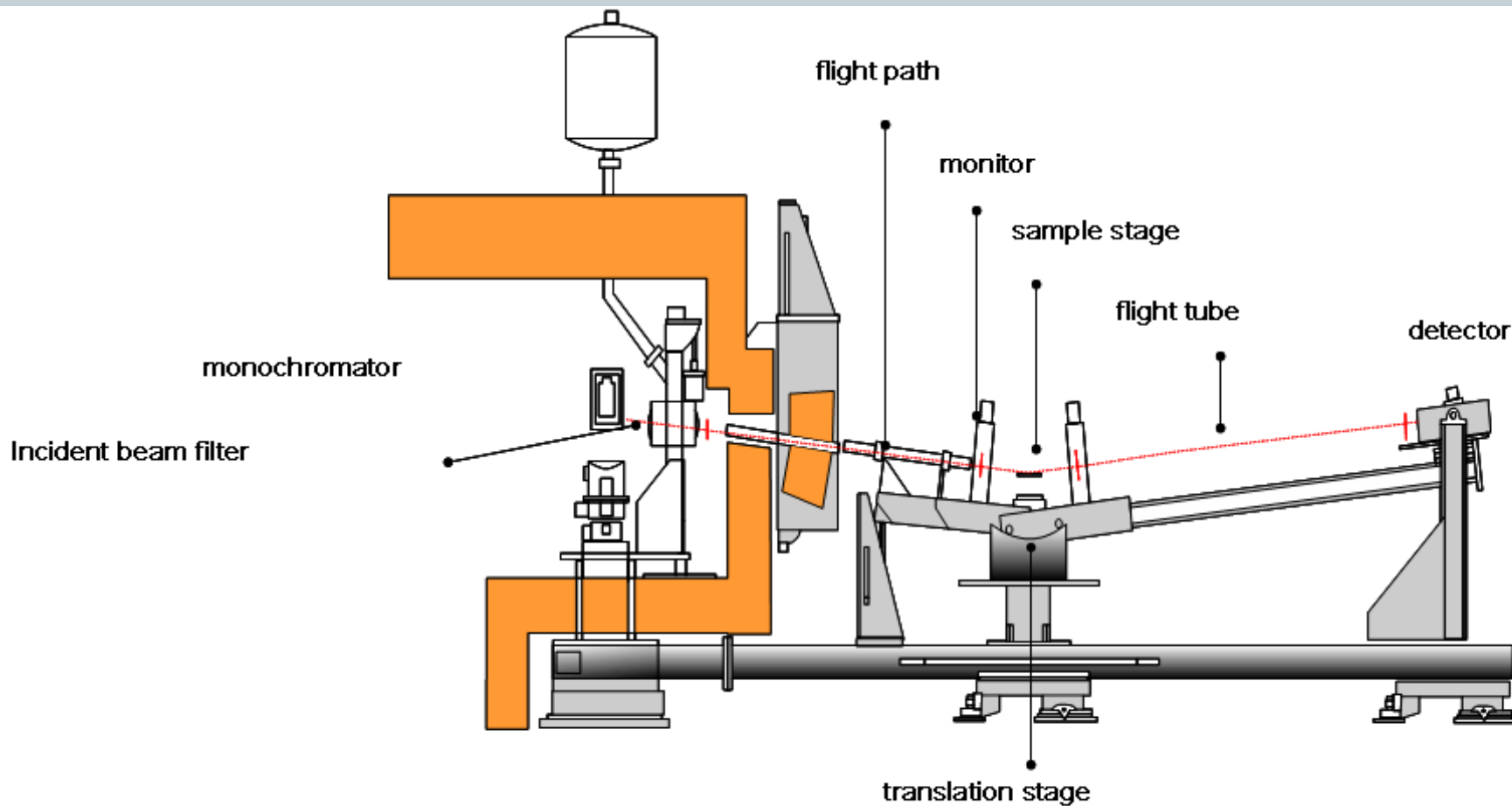


Constant drying

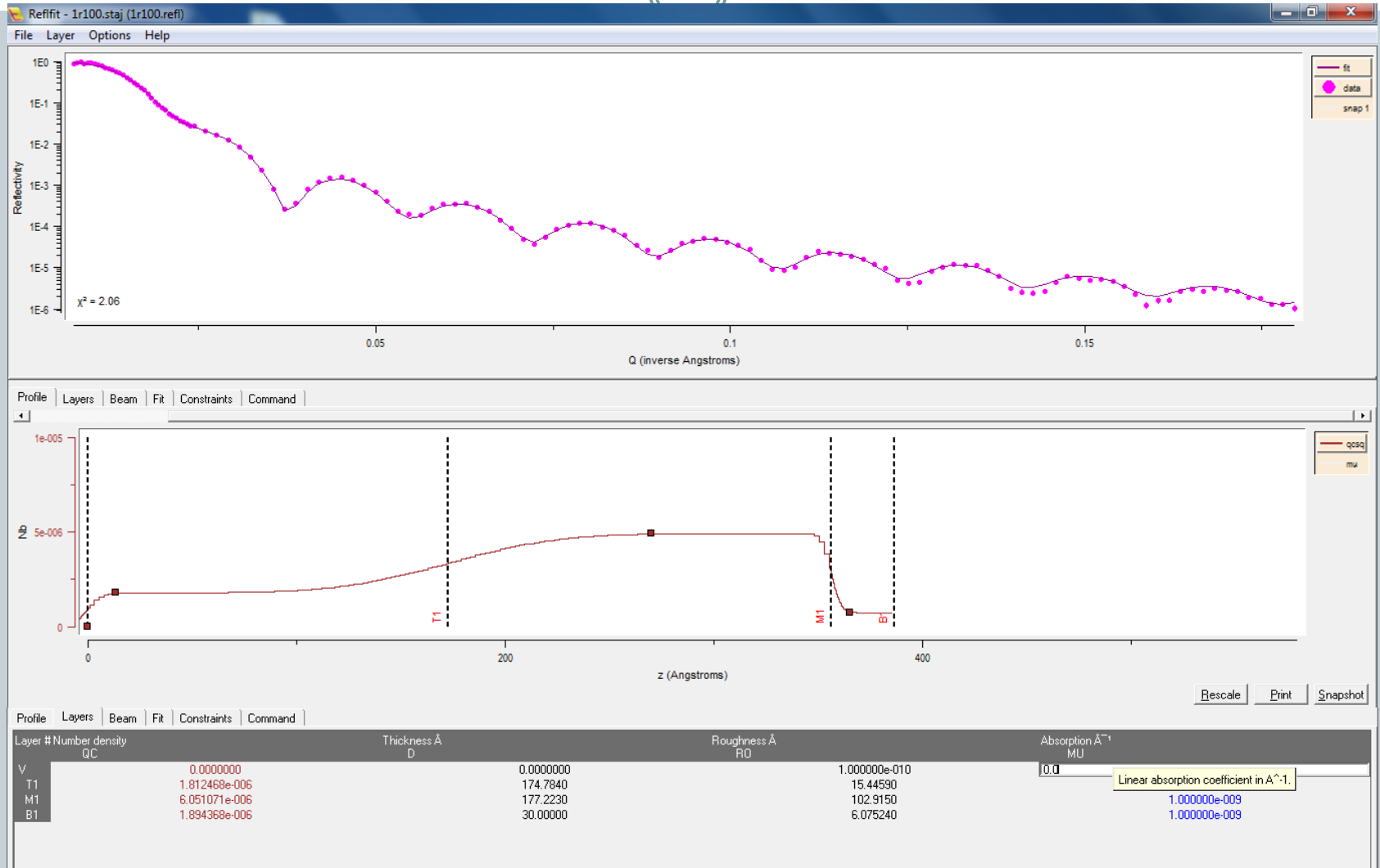
2nd layer Floating



NG7 Reflectometer Setup



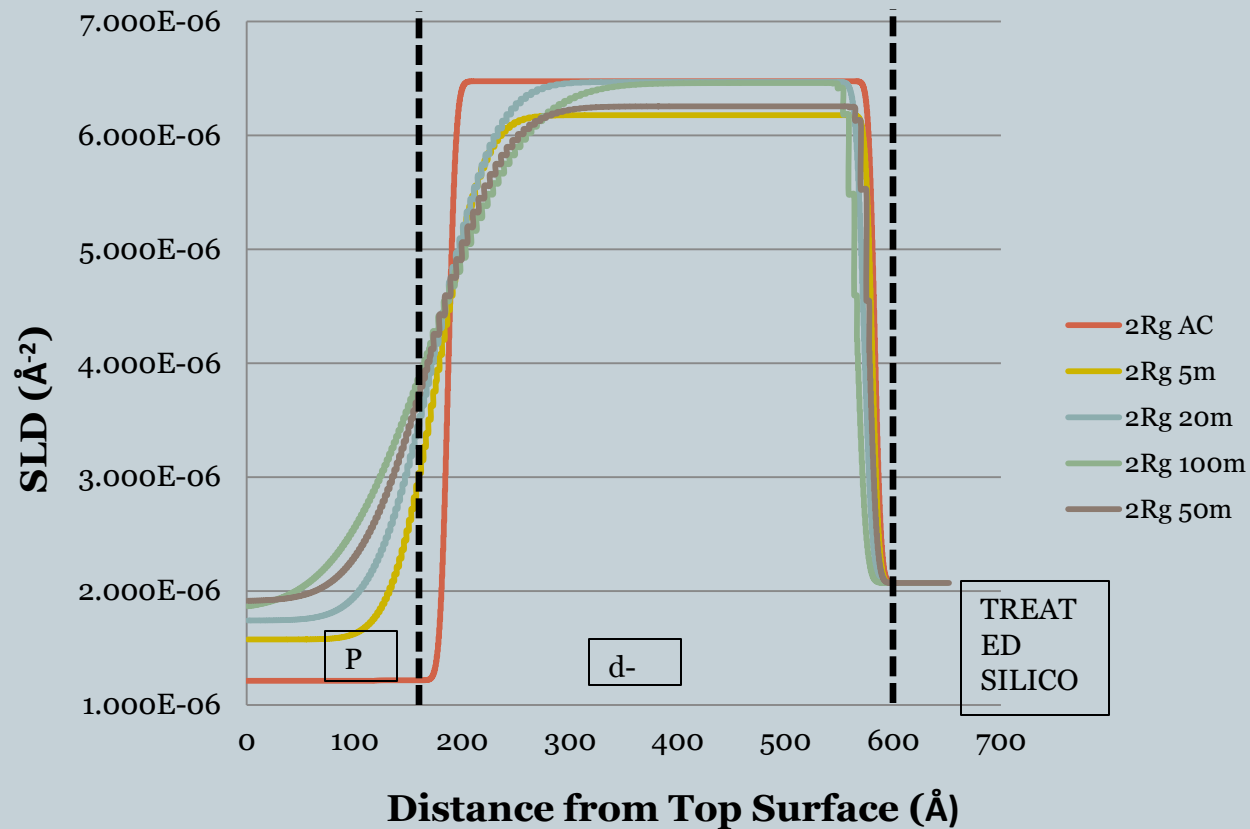
Data Regression and Fitting



Roughness Shows Interdiffusion



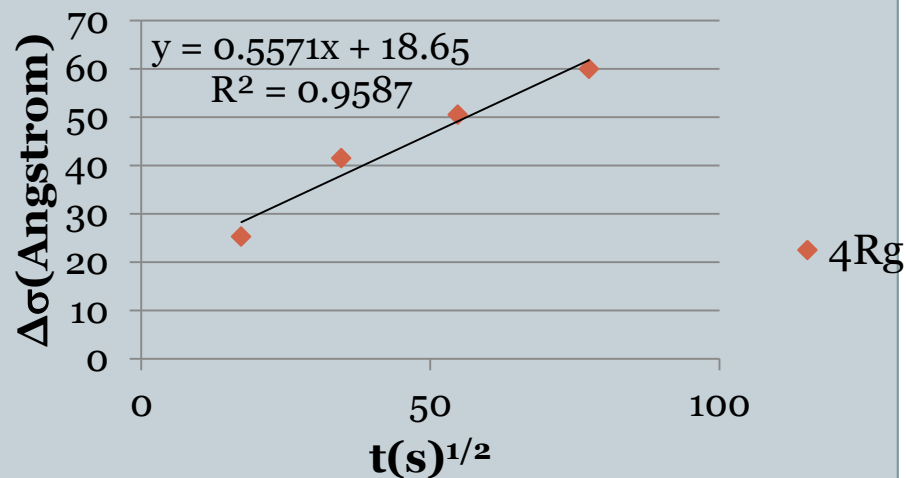
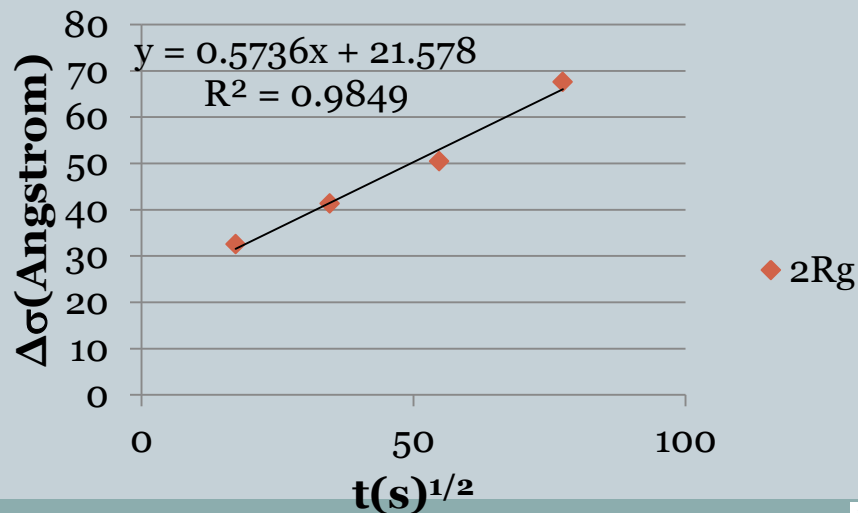
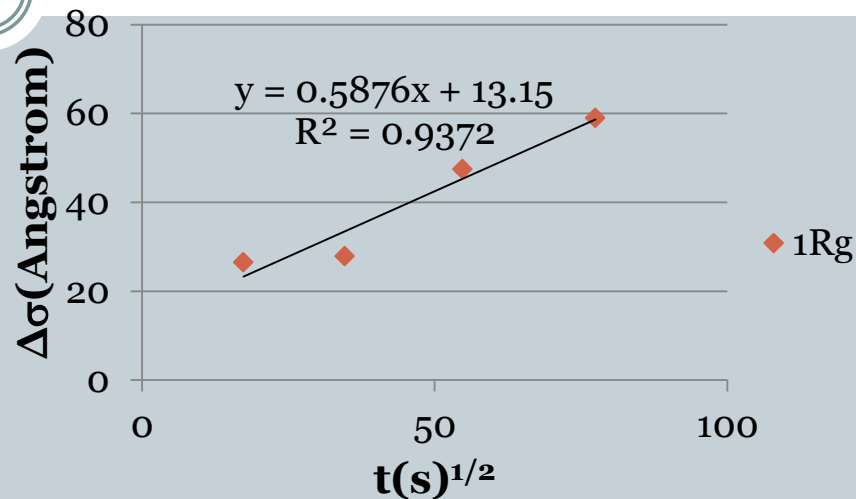
Scattering Length Density Profile



Crunch time

$$D = \sigma^2 / 2t$$

	1Rg/1Rg (Å)	1Rg/2Rg (Å)	1Rg/4Rg (Å)
0 min	3.7 ± 1.9	5.5 ± 1.5	5.4 ± 0.2
5 min	26.8 ± 0.5	33.0 ± 1.4	25.8 ± 0.9
20min	28.1 ± 2.6	41.7 ± 1.3	41.8 ± 1.0
50 min	47.6 ± 2.6	50.7 ± 1.4	50.8 ± 1.5
100 min	59.1 ± 9.8	67.8 ± 6.5	60.0 ± 2.7
D (cm ² /s)	1.68 e-17	1.68 e-17	1.55 e-17



Conclusion



- Roughness of the interface between PS and d-PS increases with annealing time
- Dynamics of polymer chains under confinement can be studied through neutron reflectometry
- No significant change in diffusion coefficients observed under different confinement conditions.
- More time points are necessary to produce more reliable fitting

Acknowledgements

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- Michihiro Nagao
- NCNR staff



Questions?



Bulent will answer