Surface flow of glassy polymer film
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Introduction
- Mw = 3000 g/mol, polystyrene (PS), Mw/Mn = 1.09, Tg = 343K
- Width experiment:
  - h1 = 90 nm
  - h2 = {14, 23, 42} nm
  - Annealing in an oven
- Profile experiment:
  - h1 = 90 nm
  - h2 = 90 nm
  - Annealing on the AFM heating stage (in situ)

Viscous fluid
Amorphous solid

T > Tg
T < Tg

The surface is not solid, it can flow.

Model
- T > Tg
- T < Tg

Experiment information
- Evidence for flow below glass transition temperature.
- Comparing to whole film flow, surface flow was observed.
- Derived a new theoretical model GTFE.
- GTFE correlation function gave the transition near Tg
- Viscosity and mobile layer were calculated from comparisons.

Comparisons

Correlation Function

Conclusions
We used a novel experiment to study the enhanced surface mobility of glassy polymer film.
- Evidence for flow below glass transition temperature.
- Comparing to whole film flow, surface flow was observed.
- Derived a new theoretical model GTFE.
- GTFE correlation function gave the transition near Tg
- Viscosity and mobile layer were calculated from comparisons.

Acknowledgements
The work is done by collaboration with McMaster University, and ESPCI, Paris.
I would like to thank my supervisor James Forrest for his help and support.

Financial support

Viscosity and mobile layer

Self Similarity


Derivation
\[ \frac{\partial h}{\partial t} = \frac{1}{\gamma} \frac{\partial}{\partial x} \left( \frac{3}{\eta} \frac{\partial^3 h}{\partial x^2} + \Delta h \right) \]