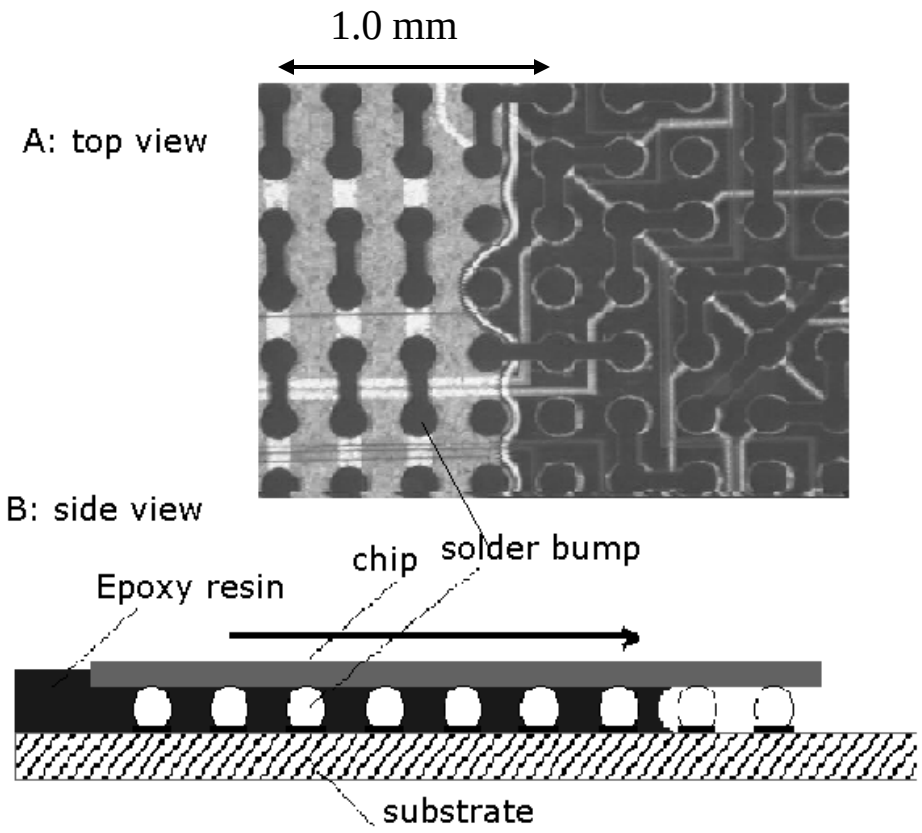
A STUDY OF THE FLOW OF DENSE SUSPENSIONS ON INHOMOGENEOUS SURFACES

BY QING PENG

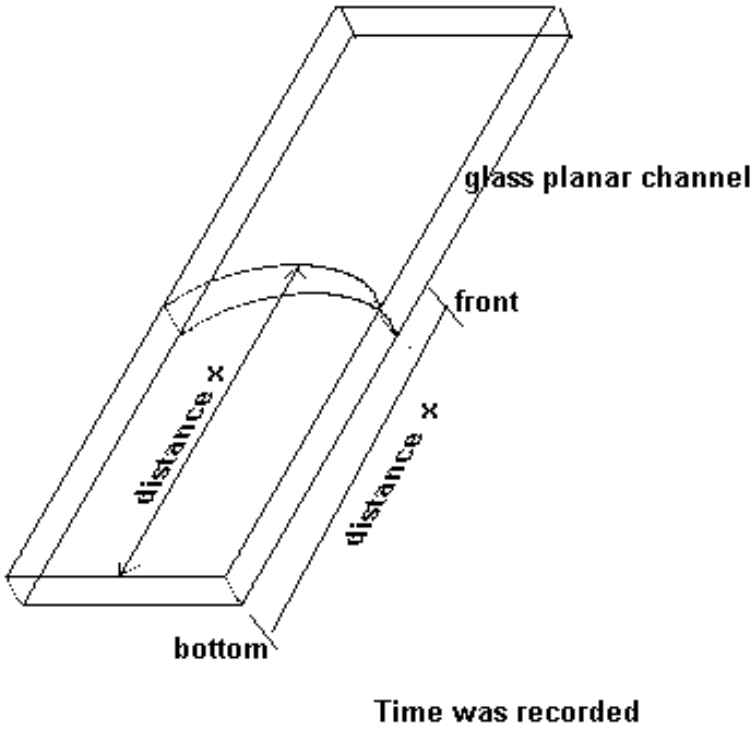
OUTLINE

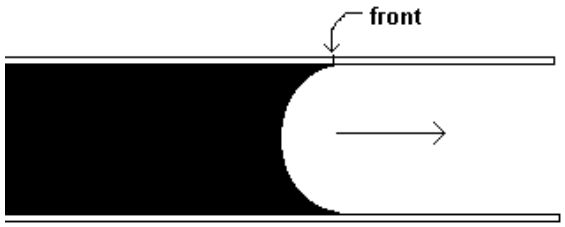
- WASHBURN MODEL
- WETTING ANGLE
- STATIC HEIGHT
- RHEOLOGY
- SUSPENSION FLOW
- COMPARISON

SUSPENSION FLOW IN INDUSTRY



STUDY THE FLOW PROCESS





Time was recorded

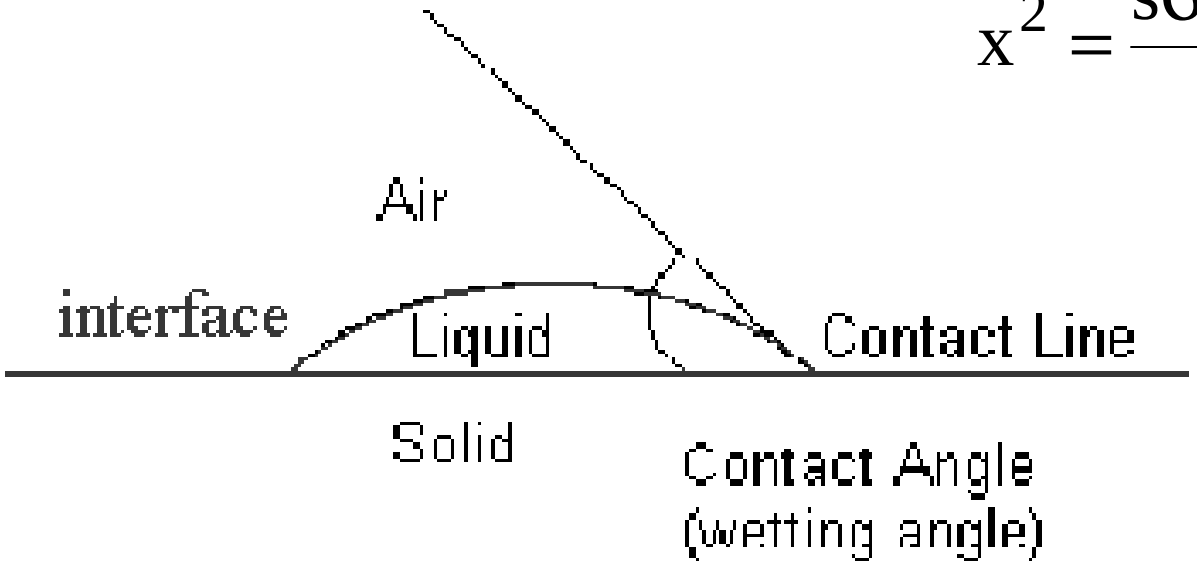
- A SIMPLE MODEL -- WASHBURN MODEL IS USED TO STUDY THE FLOW PROCESS

Washburn model

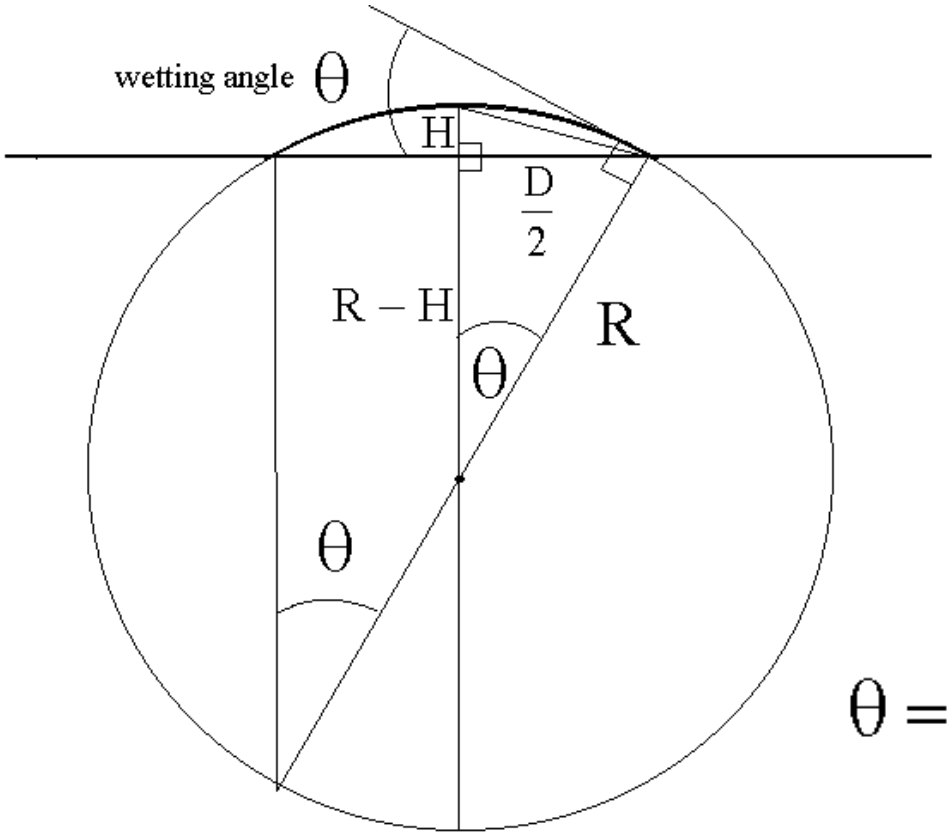
$$x^2 = \frac{s\sigma\cos\theta}{3\mu}t$$

WETTING ANGLE

$$x^2 = \frac{s\sigma\cos q}{3\mu} t$$



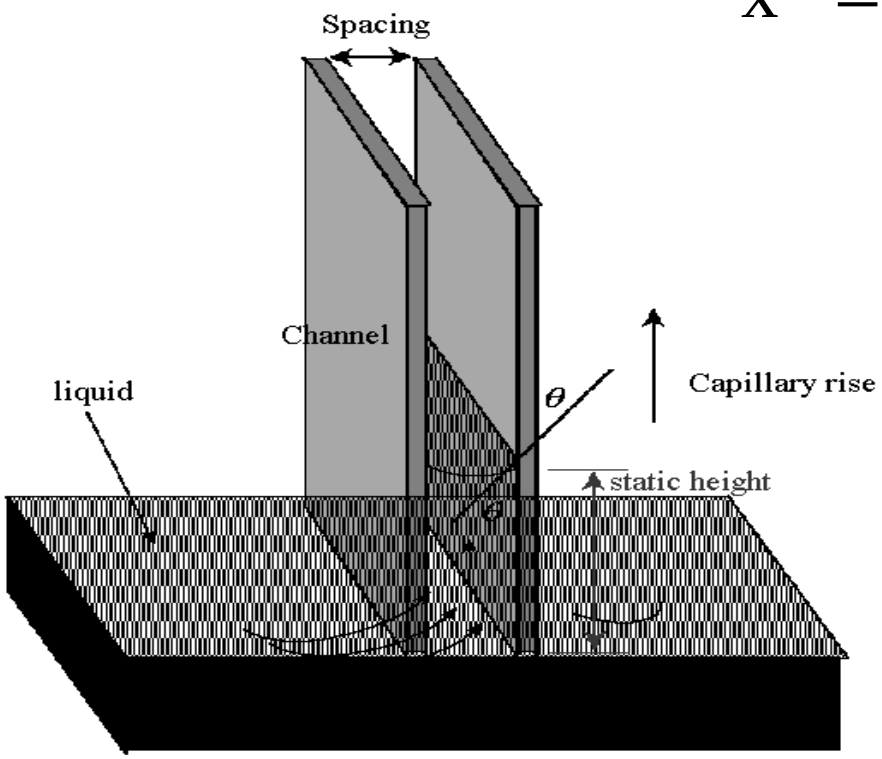
WETTING ANGLE FORMULATION



$$\theta = 2\,\mathrm{arctg}\,\frac{2H}{D}$$

STATIC HEIGHT

$$x^2 = \frac{sS\cos?}{3\mu}t$$



STATIC HEIGHT FORMULATION

$$h = \frac{2}{rg} s \cos q \bullet \frac{1}{s}$$

$$\sigma \cos\theta = \frac{\rho g}{2} \cdot \frac{dh}{d(1/s)}$$

- STATIC HEIGHT IS PROPOTIONAL TO THE INVERSE SPACE.

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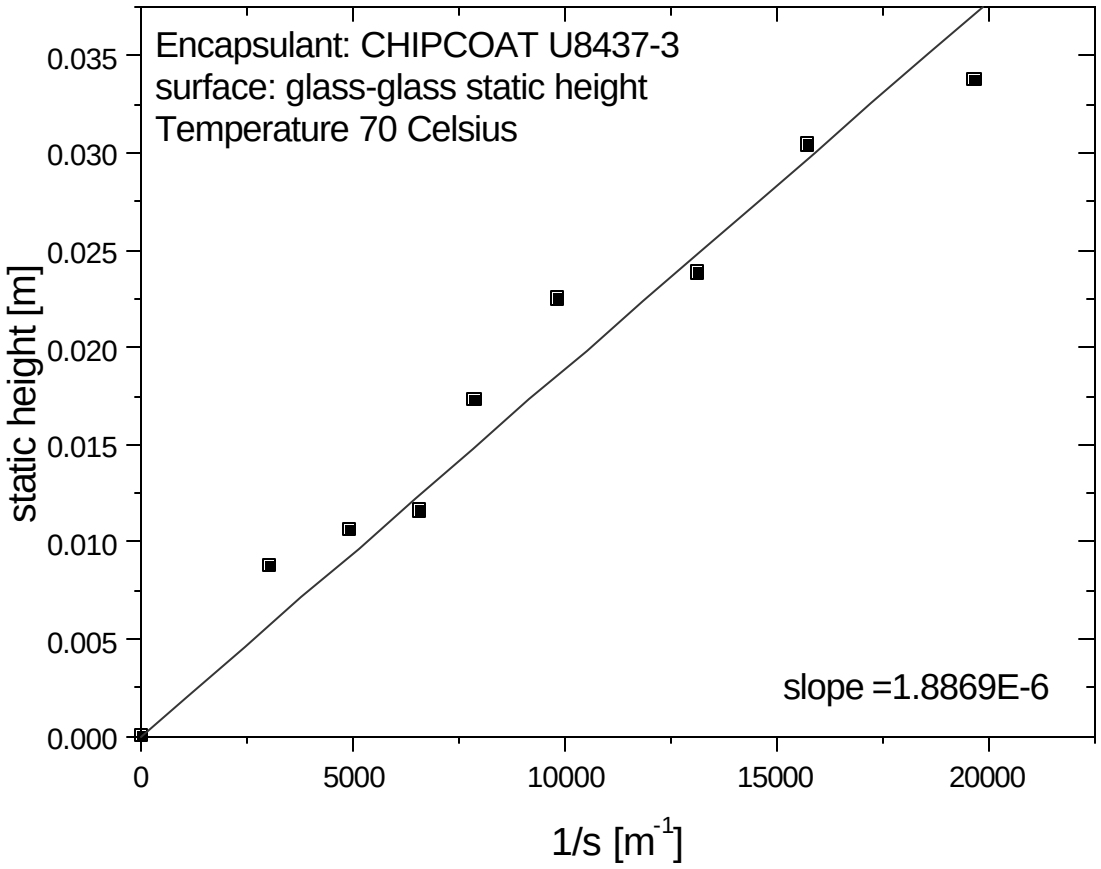
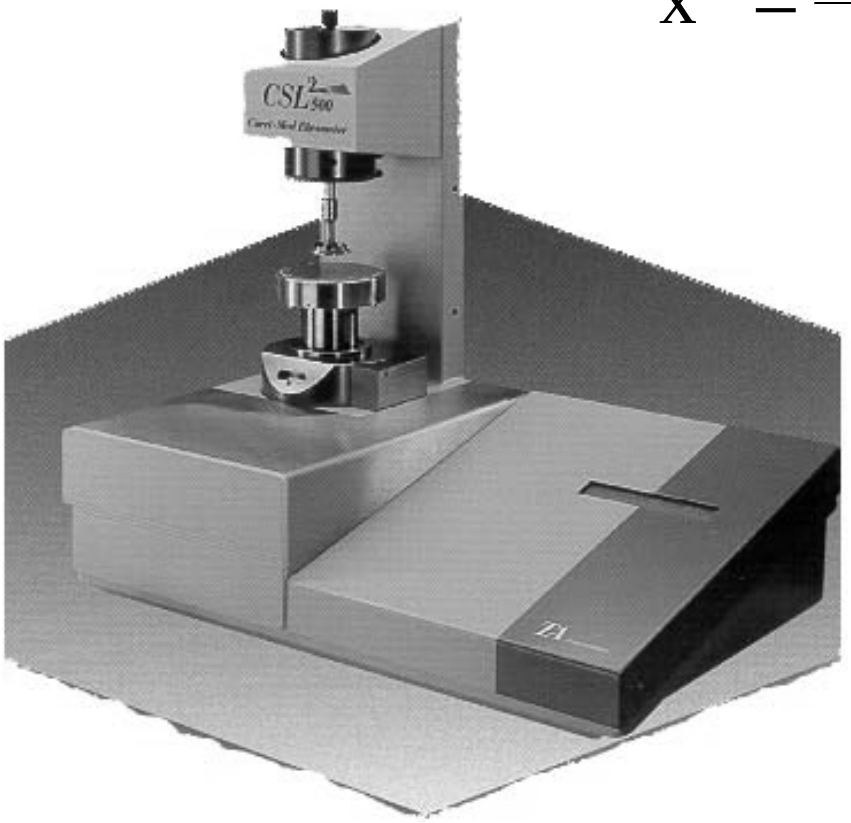
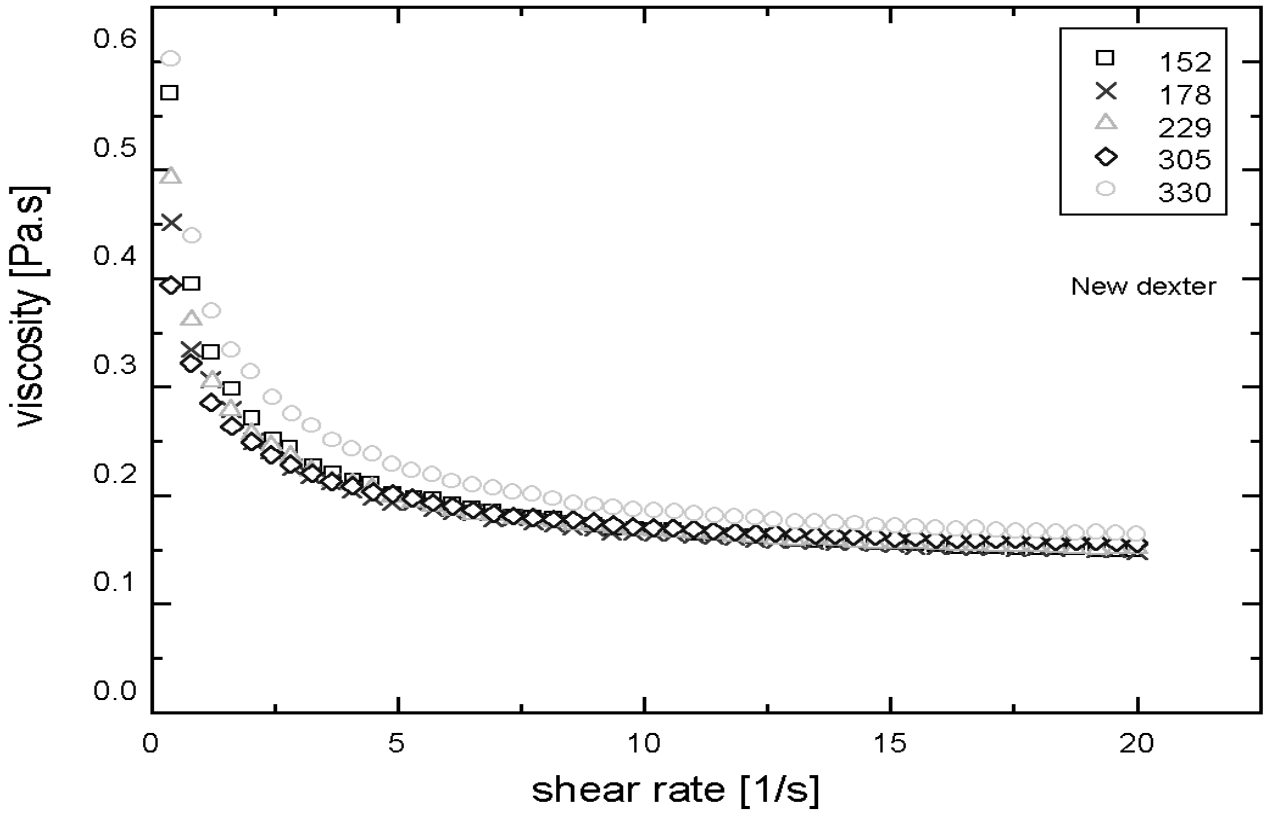


RHEOLOGY EXPERIMENT

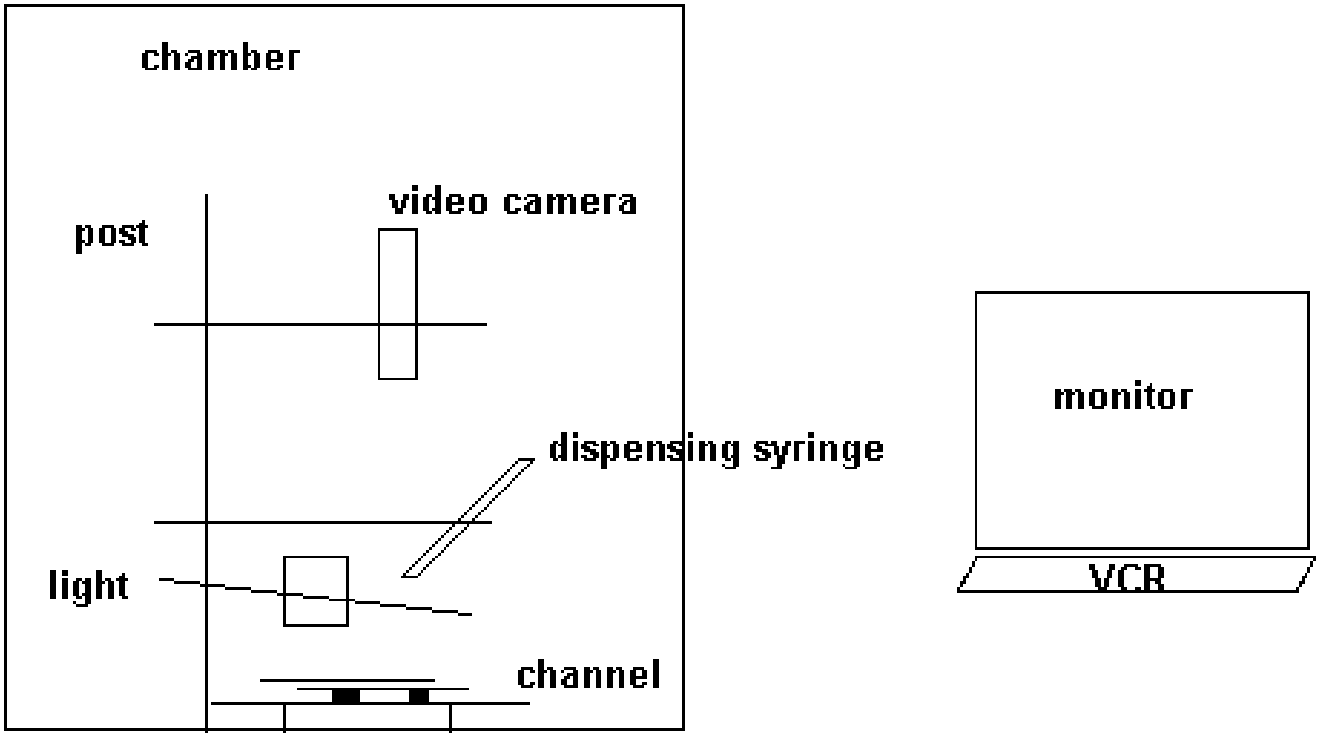
$$x^2 = \frac{s\sigma\cos\theta}{3m}t$$



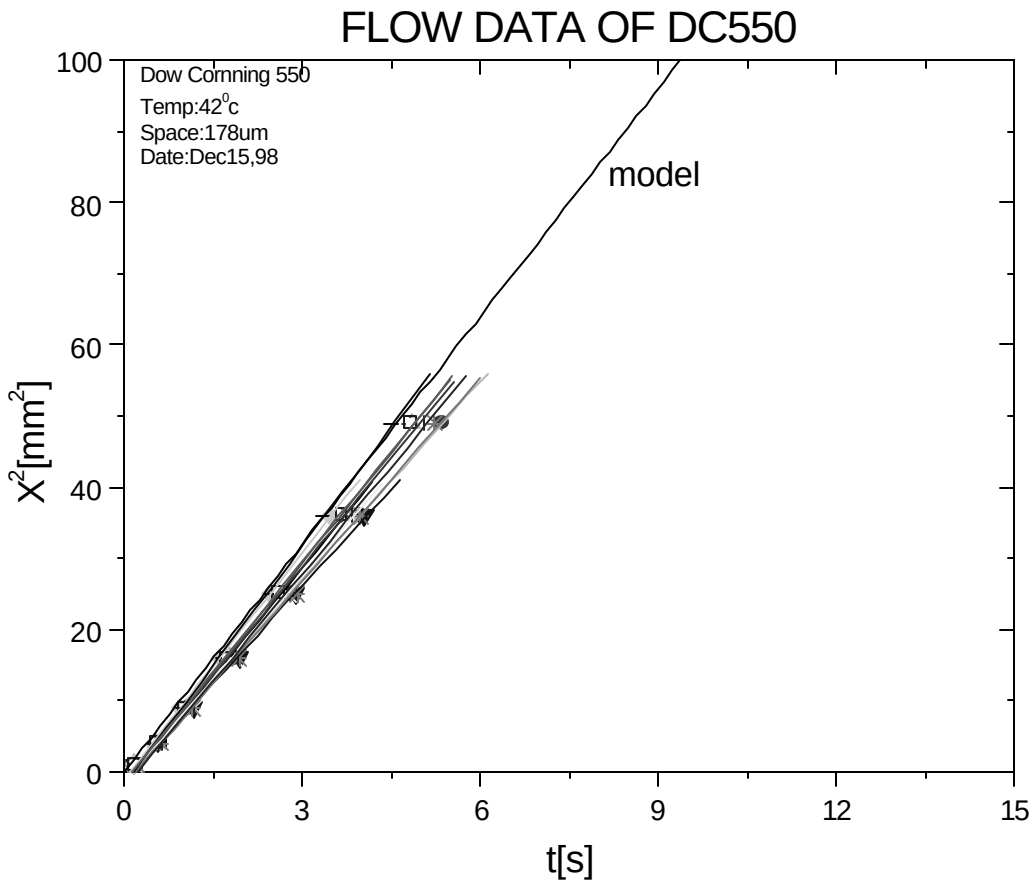
RHEOLOGY EXPERIMENT DATA OF NEW DEXTER



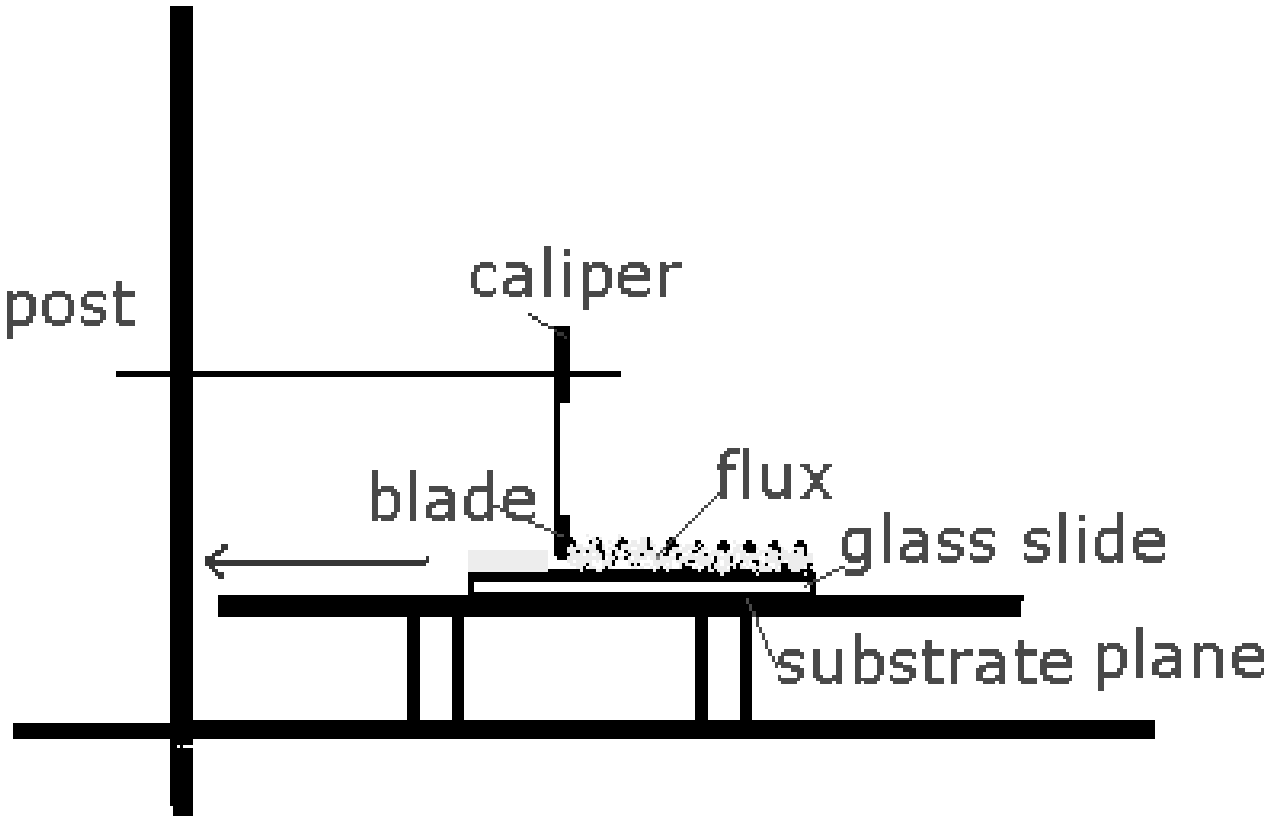
FLOW EXPERIMENT SETUP



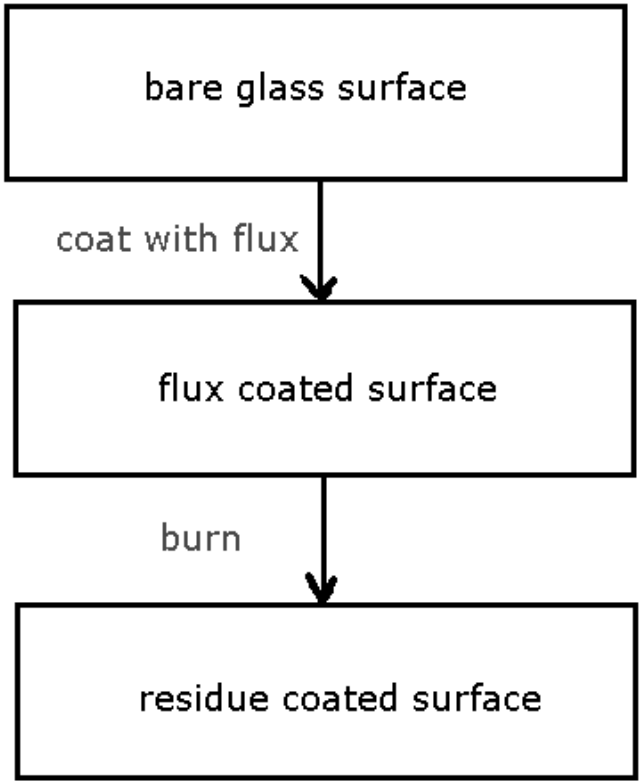
FLOW EXPERIMENT DATA AND THE COMPARISON TO THE WASHBRN MODEL



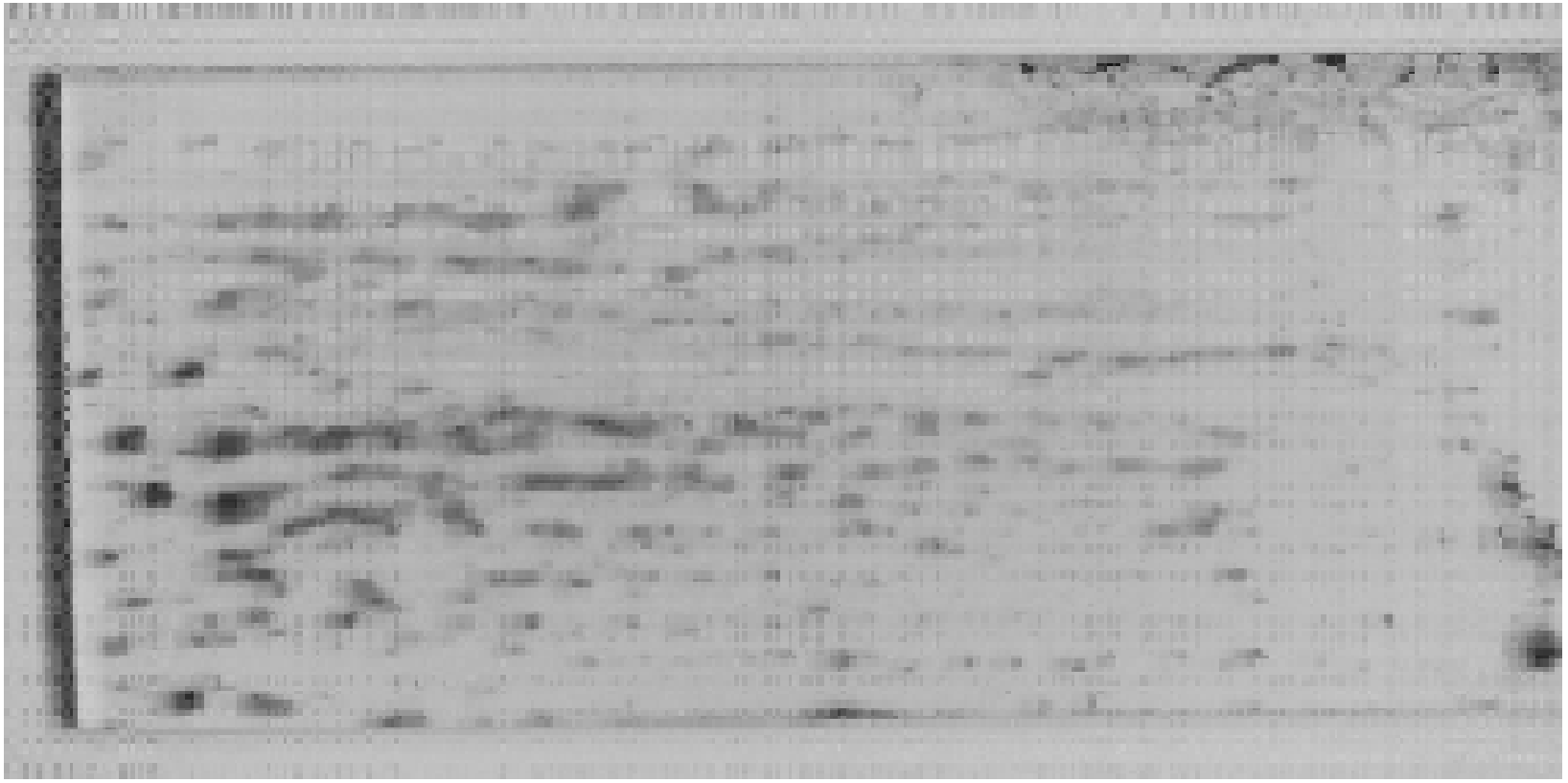
INHOMOGENEOUS SURFACE PREPARATION



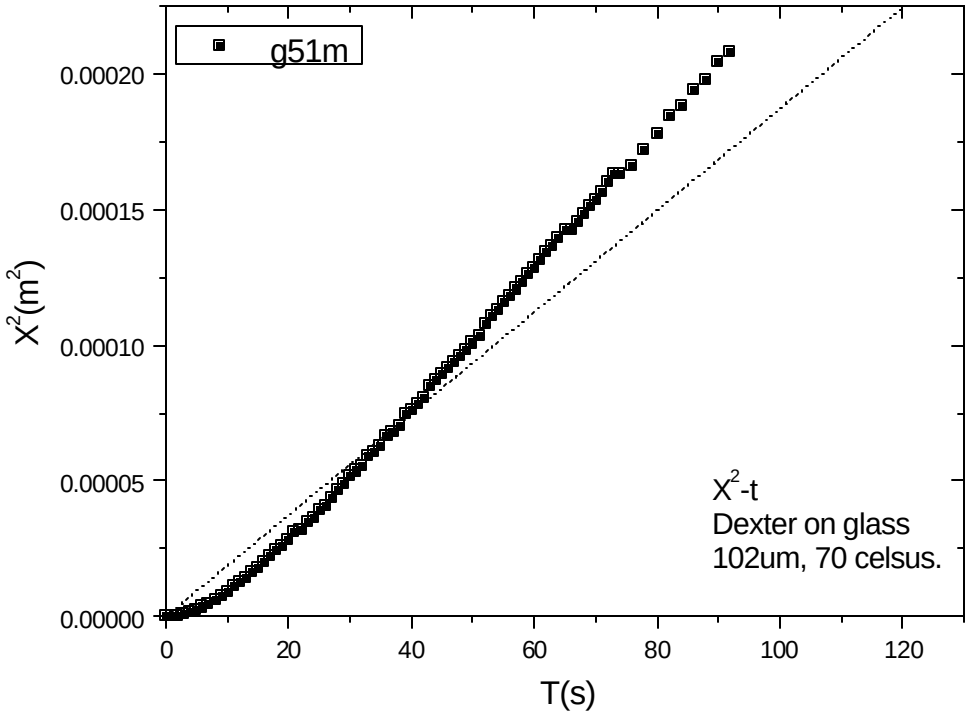
Surface coating



Inhomogeneous surface



FLOW EXPERIMENT DATA OF DEXTER ON GLASS SURFACE AND THE COMPARSON TO THE WASHBURN MODEL



COMPARISON FORMULATION

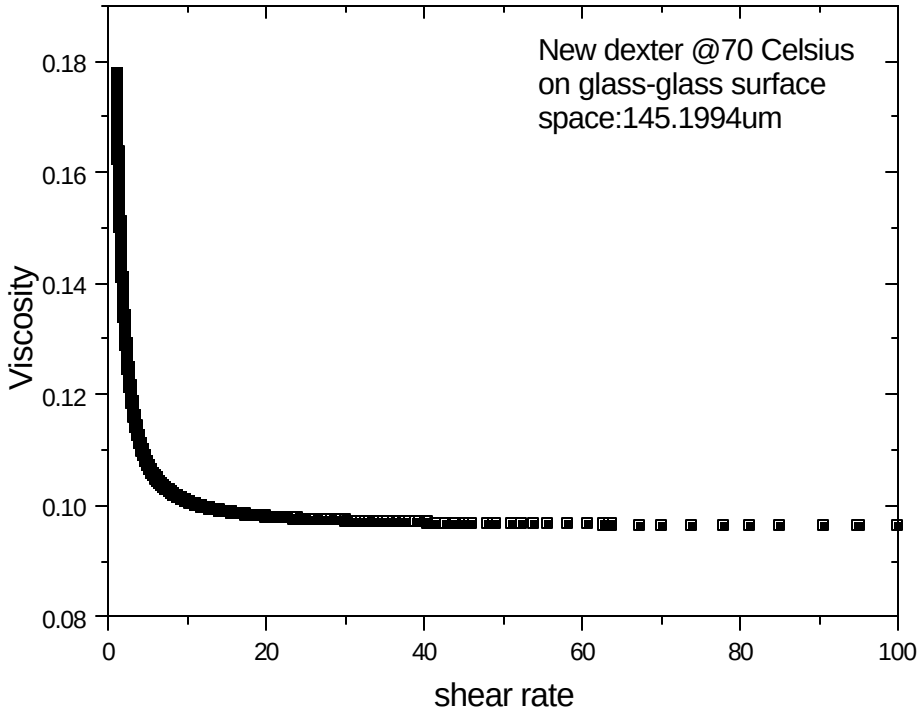
$$X^2 = \frac{s\ \cos q}{3m} \cdot S \cdot t$$

$$X_f^2 = P_1 + P_2 t + P_3 e^{-t/P_4}$$

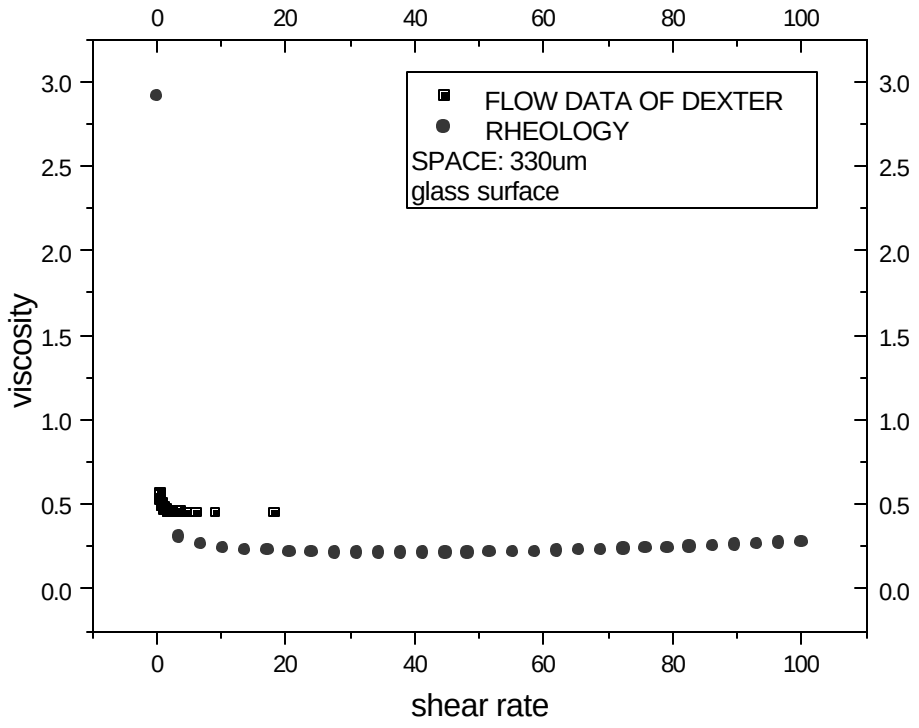
$$m = \frac{s\ \cos q}{3}\, s\left[\frac{1}{P_2 - \frac{P_3}{P_4} e^{-t/P_4}}\right]$$

$$\dot{g} = -\frac{3U_{mean}}{s} = -\frac{3b}{2xs}$$

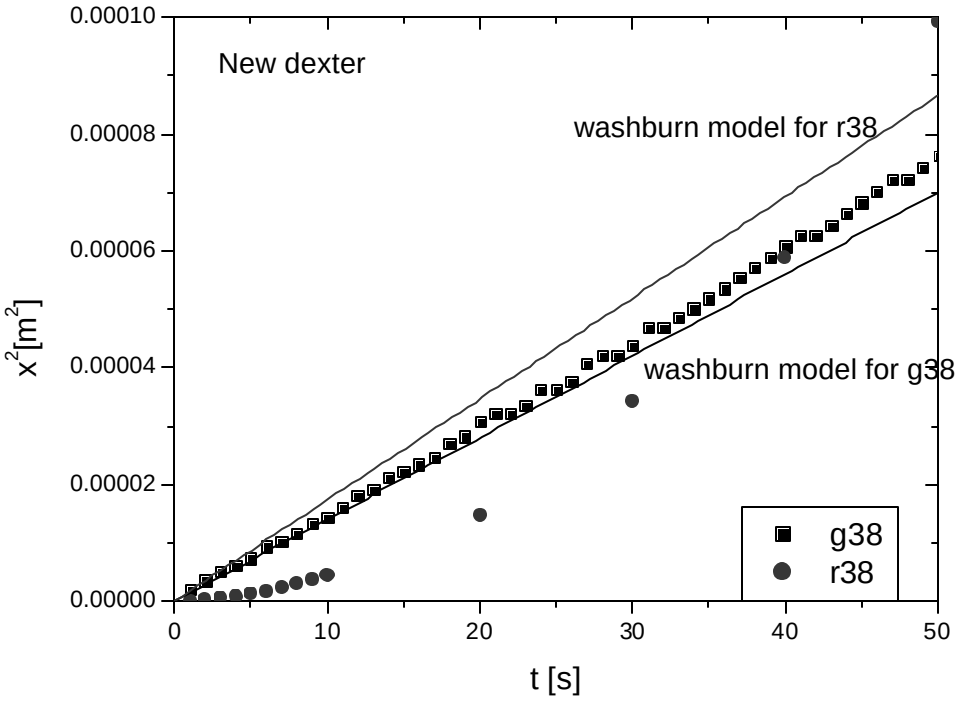
FROM THE FLOW DATA, THE VISCOSITY VERSUS SHEAR RATE CAN BE CALCULATED



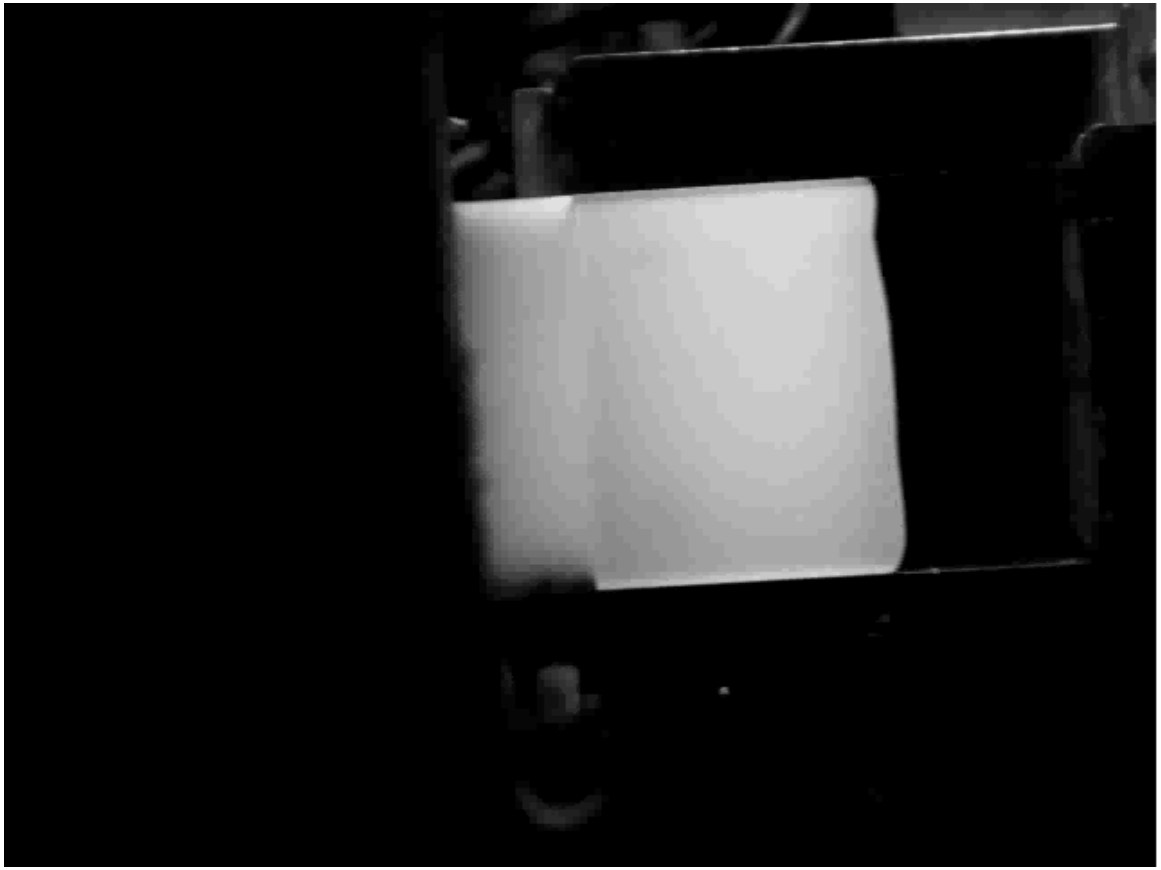
VISCOSITY COMPARISON OF DEXTER



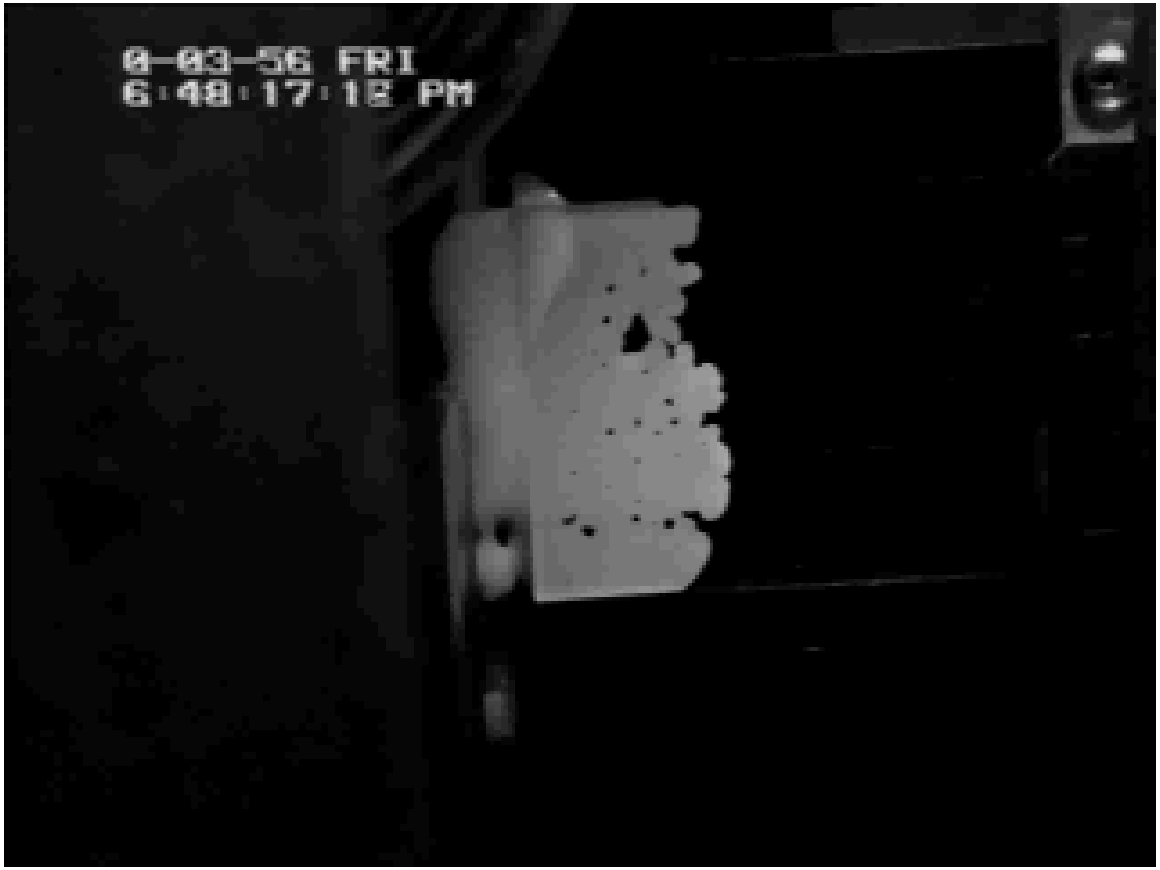
Surfaces comparison



Dense suspension on glass surface



Dense suspension on inhomogeneous surface



Discussion and conclusion:

- Simple capillary flow fits the washburn model.
- For dense suspension, wetting on reside-coated surface is about the same as on glass. (For example: the wetting angle of new dexter on glass is 12.37 degree and 12.84 degree on residue surface. Sigmacosine theta is 0.0172 for glass and 0.0213 N/m*m for residue surface.)

Voids come out because of topologies--dense suspension tends to go around the obstacles instead of going over them