

ESDU SPB-M4-1

Interfacial and rheological properties of asphaltenes investigated using AFM



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Sub-project B

Interfacial and Rheological Properties of Asphaltenes Investigated using AFM

**Department of Chemical Engineering
and Chemical Technology**

25 September 2007

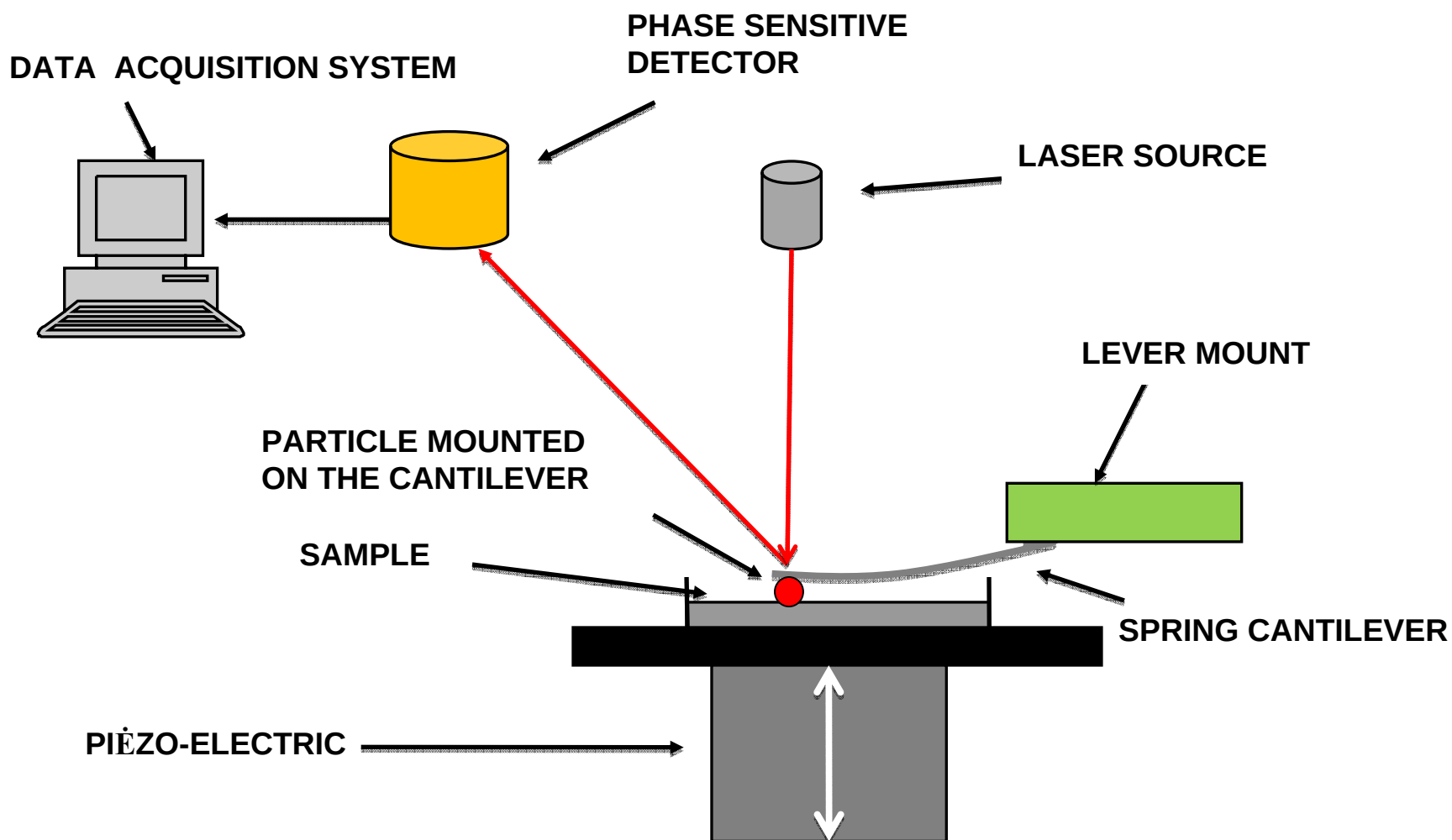
**Prof. Paul F. Luckham
Dr. Mahtab Behrouzi**



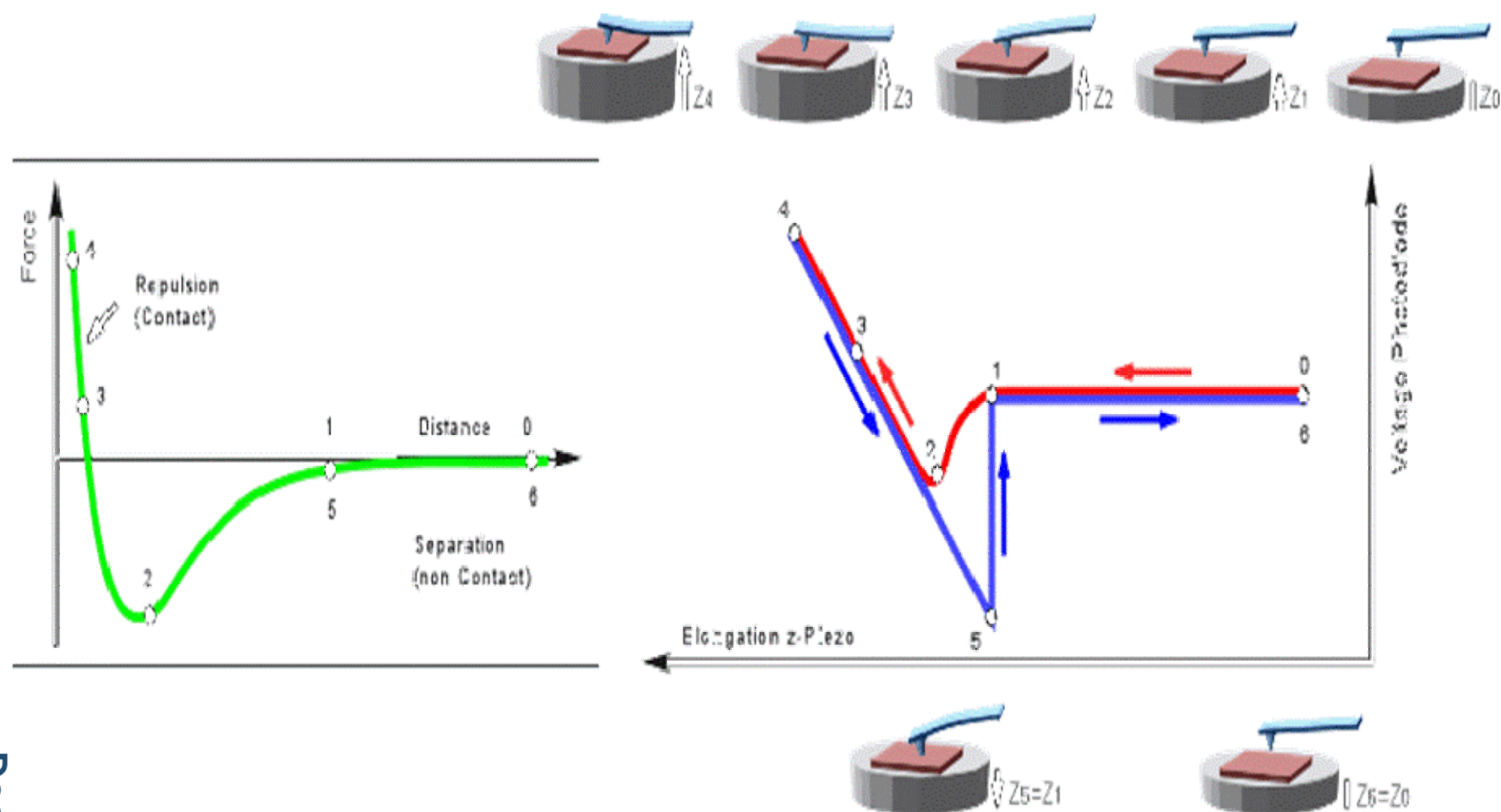
Objectives

- Investigation of the deposition of asphaltenes onto the surfaces of reservoirs and heat exchangers through monitoring
 1. Adsorption and adhesion of asphaltenic materials
 2. Rheological properties of asphaltenes, such as shear stress, and viscosity of deposited materials at the interface
- Exploitation of an Atomic Force Microscopy (AFM)
 1. Measuring the interaction forces between asphaltenic particles
 2. Stress-Relaxation of asphaltenic surfaces
 3. Imaging the deposited surfaces and interfaces

Atomic Force Microscopy Setup



Force Measurement Cycle



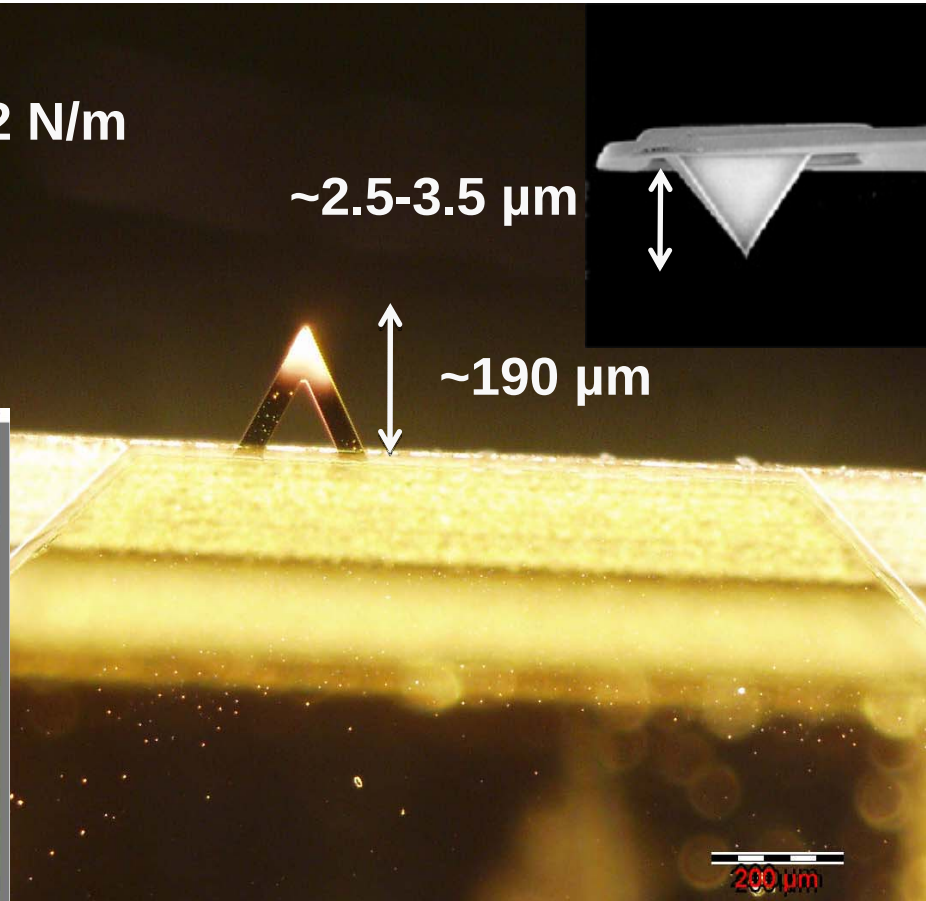
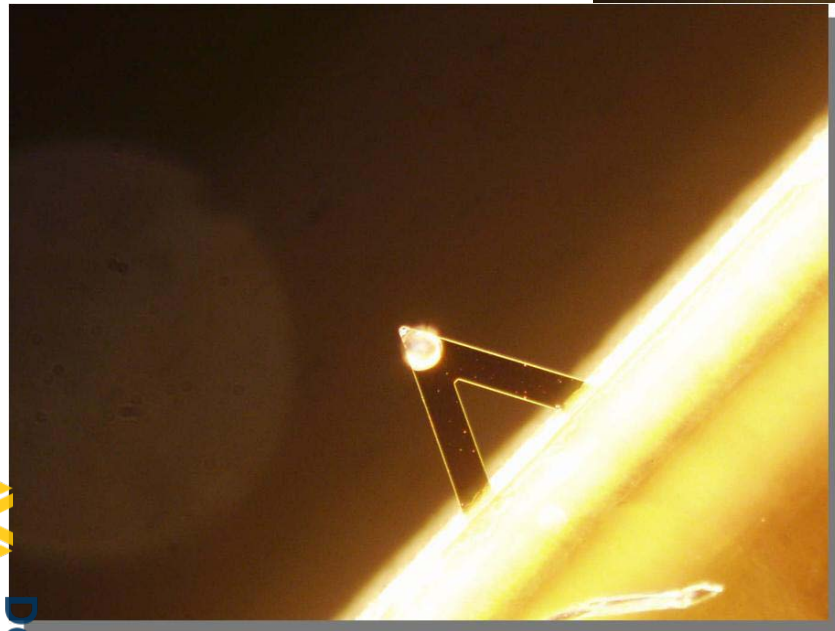
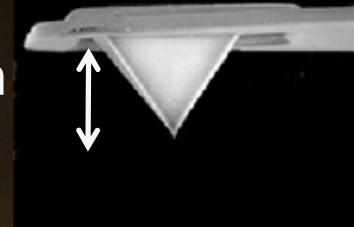
Cantilevers

Particle mounted
on the Cantilever

$$K = 0.12 \text{ N/m}$$

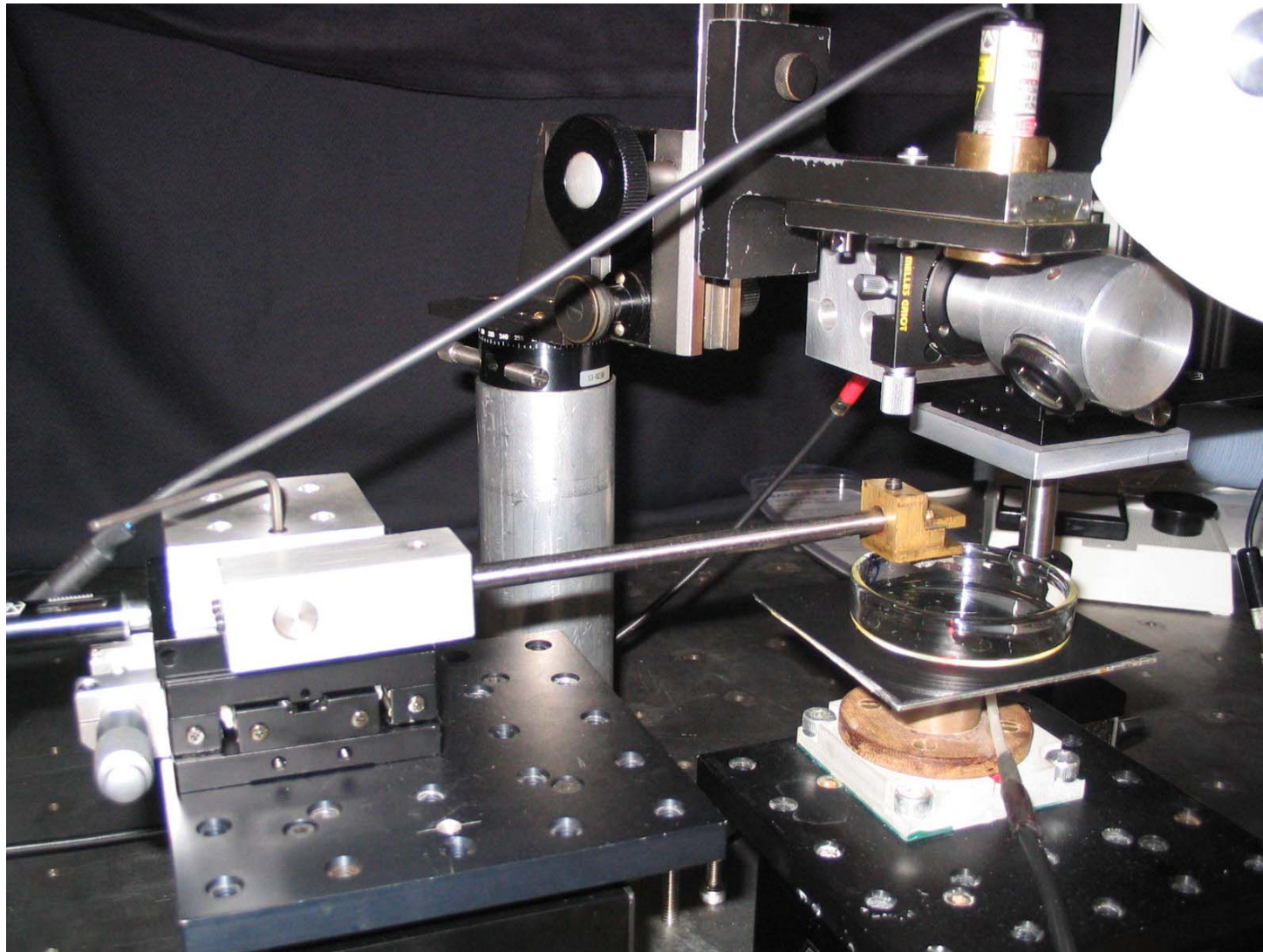
$\sim 2.5\text{-}3.5 \text{ }\mu\text{m}$

$\sim 190 \text{ }\mu\text{m}$



Cantilever with tip (Si_3N_4)

Home-Built Atomic Force Microscopy



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AFM Experiments: Background

- Measurement of interaction forces between polystyrene particles and asphaltenes surfaces
- 20 μm polystyrene particles, the packing of the size exclusion chromatography columns, used in force measurement using AFM vs. asphaltenes surfaces
- The purpose of these experiments was to investigate the possible interactions between the PS particles (the SEC column packing) and asphaltenes