



# Electrodeposition of Asphaltenes

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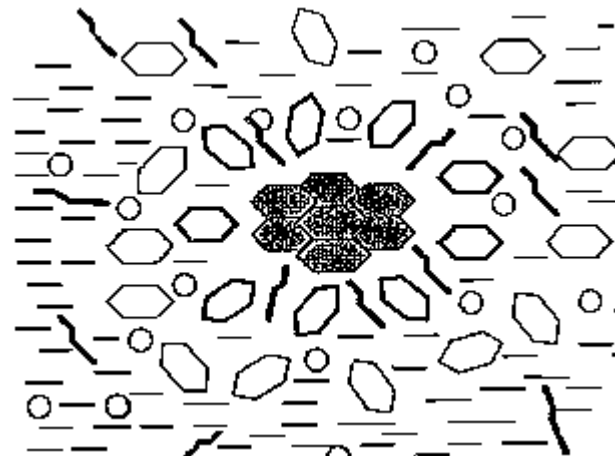
# Overview

- Introduction: asphaltenes
- Analysis of oil fractions (IR spectroscopy)
- Electrodeposition of asphaltenes
- Experiments on the electrodeposition
- Conclusions

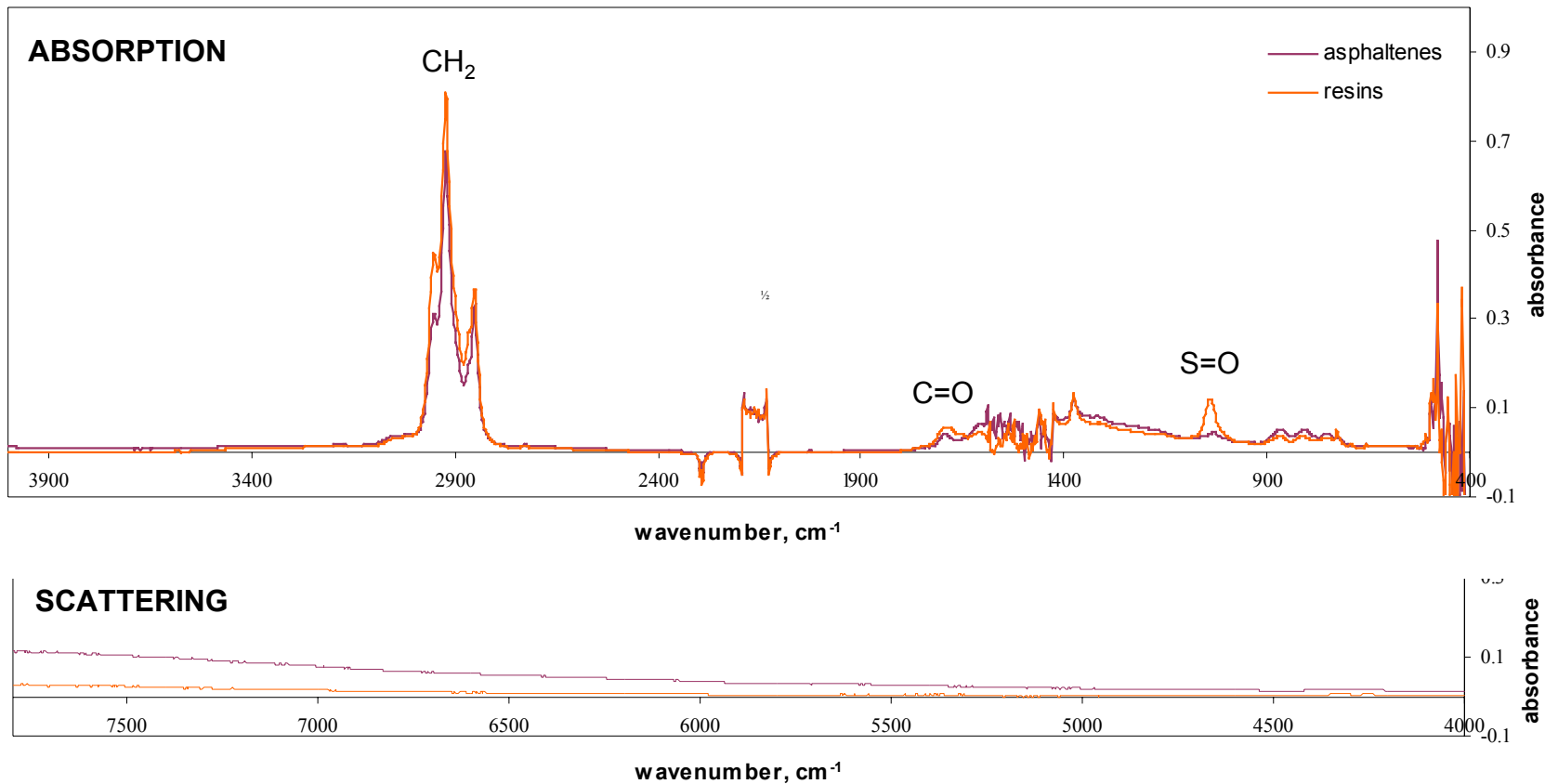
# Introduction

## Asphaltenes and Resins

- Asphaltenes: toluene-soluble, heptane-insoluble fraction of oil
  - Heavy polyaromatic molecules with some heteroatoms
  - Possess complex colloid properties
- Asphaltenes: precipitation during recovery and refinery operations → **problems**
- Resins: another petroleum fraction, less aromatic than asphaltenes
  - Resins: stabilization of asphaltenes in the crude



# IR Spectra of Asphaltenes and Resins

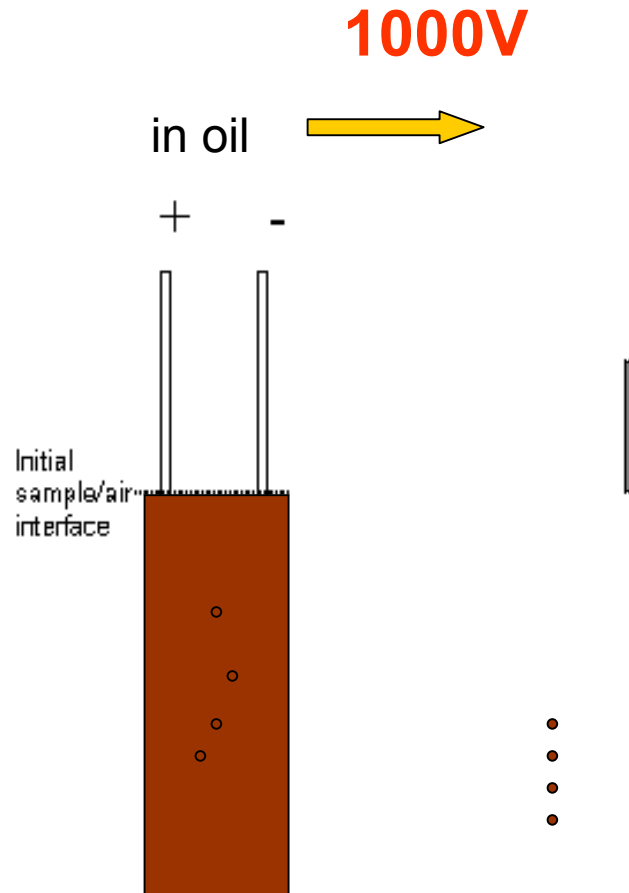


concentration 10g/L CS<sub>2</sub>

# Electrodeposition of asphaltenes: old and new

- Only a few papers available over 60+ years
- Deposit only if flocculated particles are present in the system
- Before: Deposition only on one of the plates
- Taylor (1998): resins are charged negatively, asphaltenes are charged positively
- Andersen (2000): charge reversal when moved from oil to heptane

# The Discovery: Charge reversal of asphaltene particles

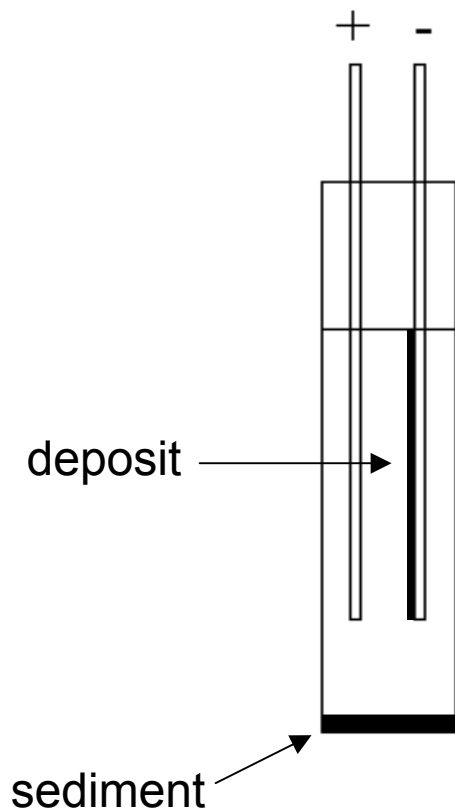




# Systems investigated for electrodeposition

- Oil/heptane mixtures (R/A ratio 2,15:1 wt)
- Asph dispersions in heptane
- Asph dispersions in nonylphenol/heptane mixtures
- Asph+resin dispersions in heptane
- Asph dispersions in toluene/heptane mixtures

# Experimental conditions



Concentration of asphaltenes in all dispersions:  
4g/L

Parallel stainless steel electrodes  
width 1 cm, length 5-6 cm, spacing 1 cm

Electric field 1000 V

Time: up to 17 hrs

# Charge of deposit

negative

oil/heptane  
(R/A 2,15:1 wt)

zero

(no deposition)

(R/A 2,2:1 wt)

(tol 16-20% vol)

positive

Asph in heptane

Asph in  
nonylphenol/heptane

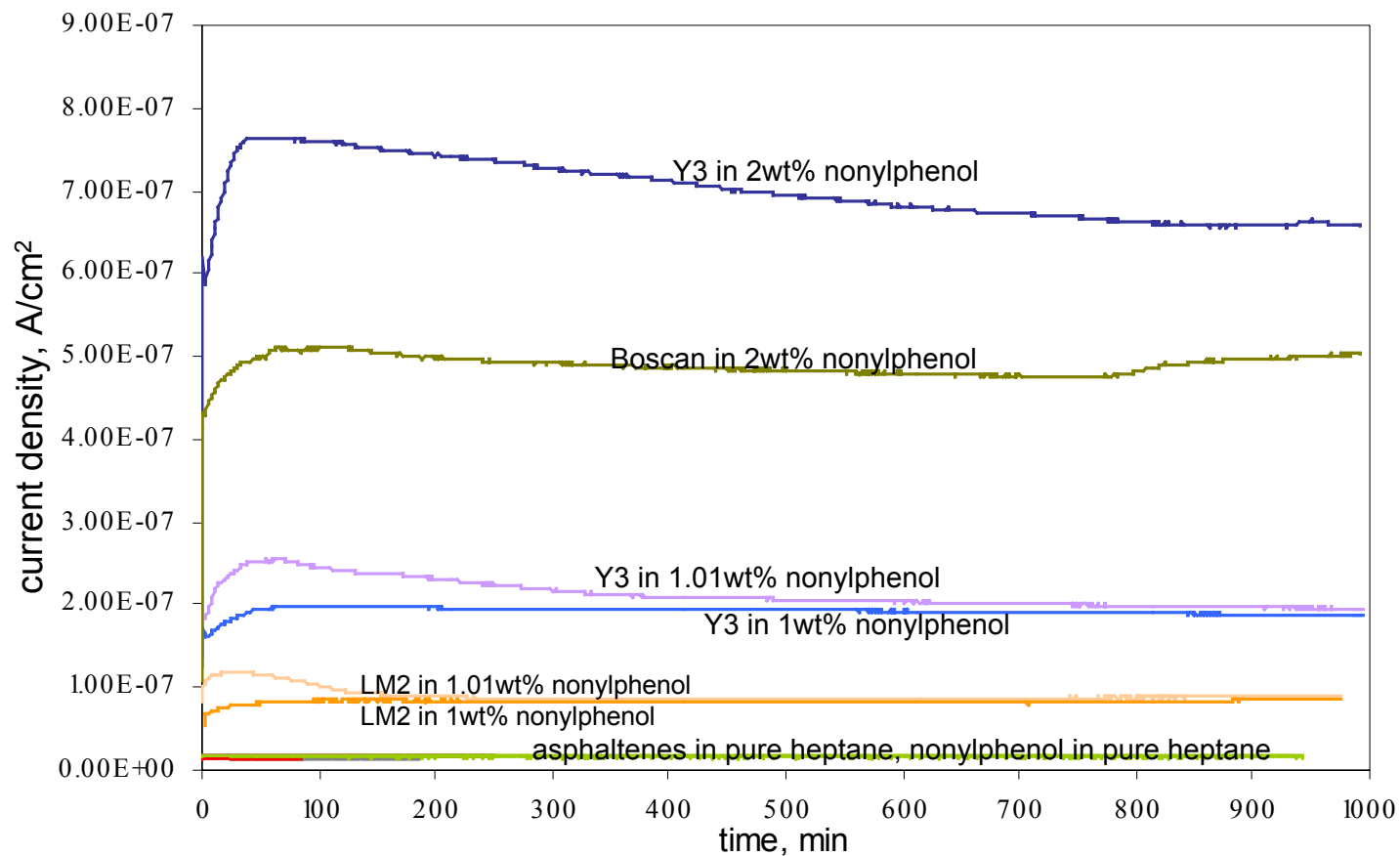
Asph+resins  
in heptane (R/A 1:1 wt)

\*Asph in  
tol/heptane  
(toluene 4-12% vol)

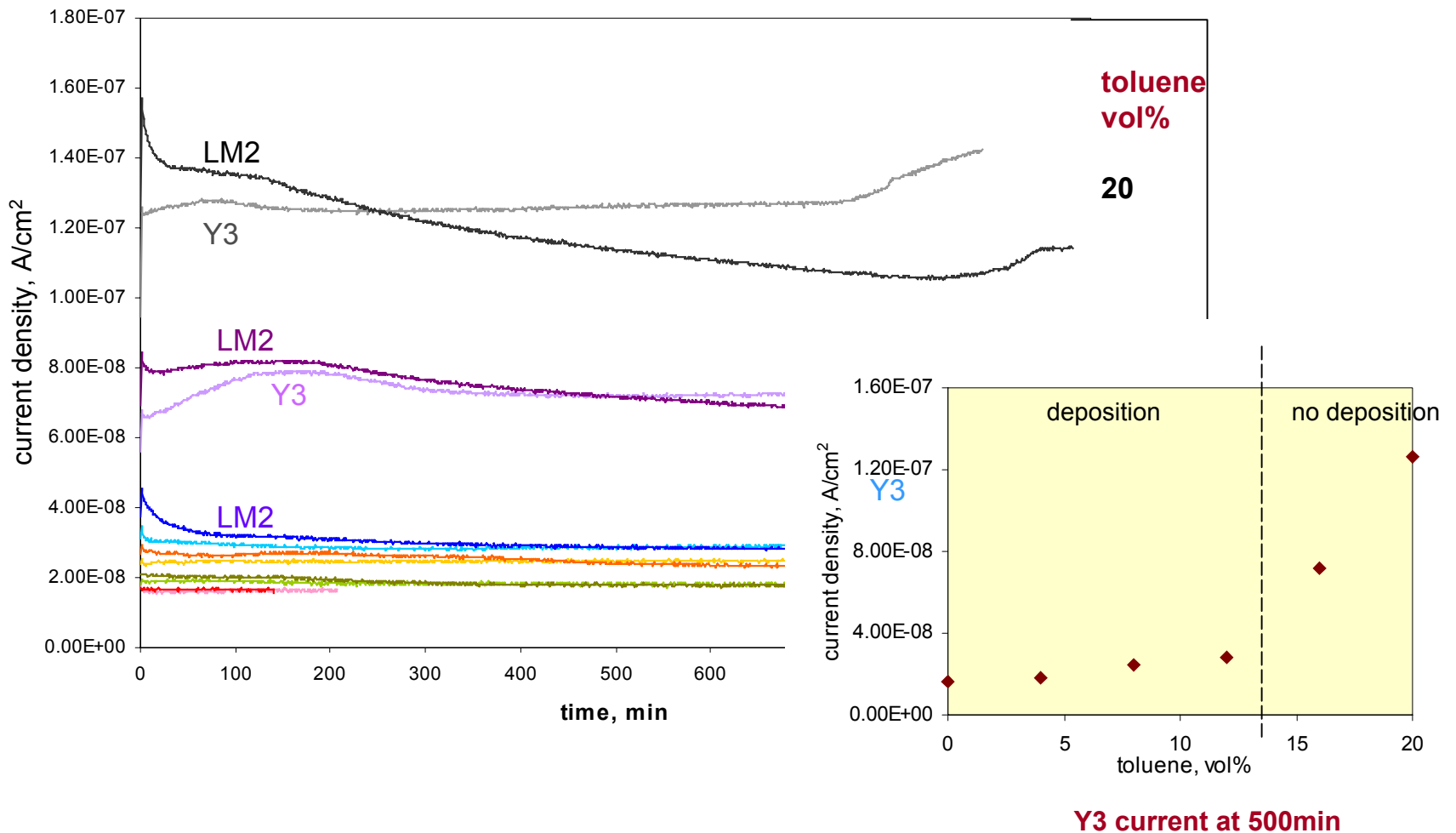
\* dispersions are prepared by weighing a solid asphaltene, adding heptane and toluene, and ultrasonicated the mixture for 60 minutes

# Chronoamperometry

## Asphaltenes in nonylphenol/heptane mixtures



# Asphaltenes in toluene/heptane mixtures



# Effect of the sample preparation procedure

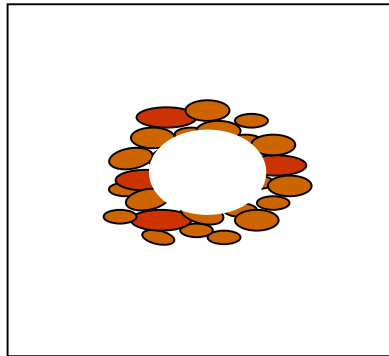
samples prepared by ultrasonicing asphaltenes, heptane and toluene together

<b>negative</b>	zero (no deposition)	<b>positive</b>
oil/heptane	Asph in tol/heptane <b>(tol 16-20% vol)</b>	Asph in heptane Asph in tol/heptane <b>(toluene 4-12% vol)</b>

samples prepared by dissolving asphaltene in toluene and adding heptane afterwards

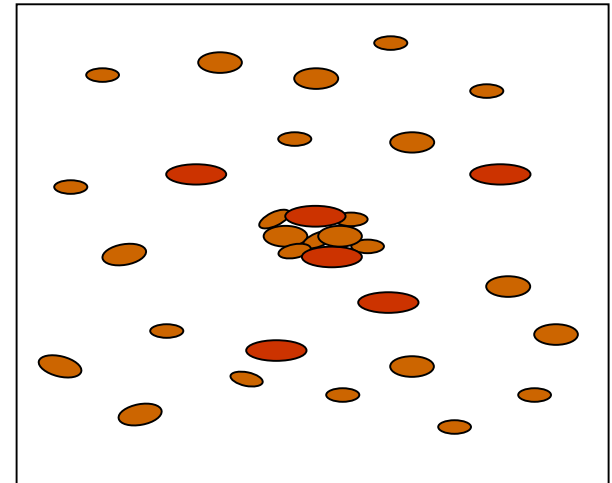
Asph in tol/heptane <b>(tol 20% vol)</b>	← Asph in tol/heptane <b>(tol 12-16% vol)</b>
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# Possible mechanisms



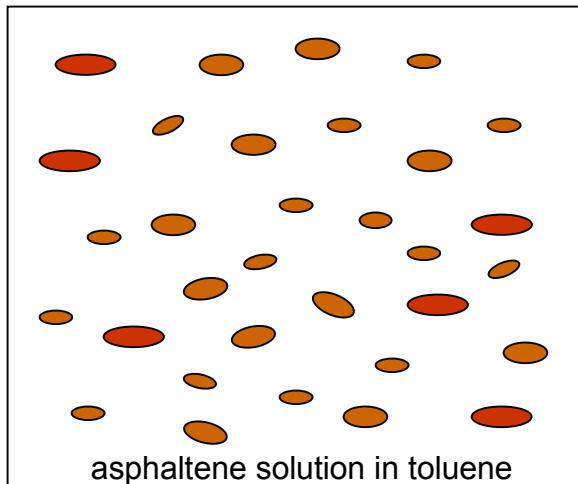
ultrasonication of a solid asphaltene with toluene and heptane

**erosion**



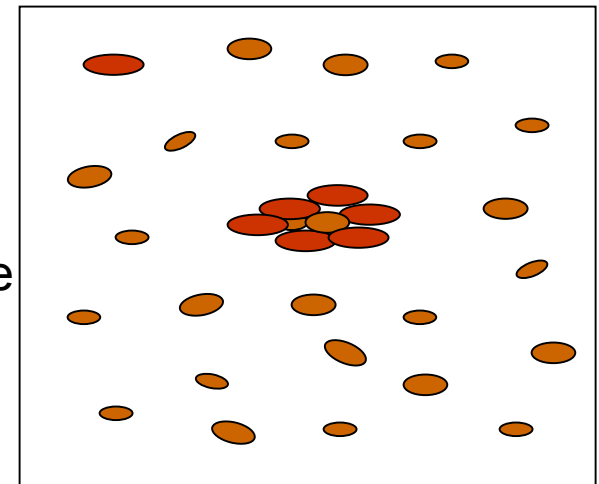
+

0



precipitation with heptane from an asphaltene solution in toluene

**formation**



0

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# Conclusions

- The way of preparing the sample plays a great role
- Resins do not possess a net negative charge
- The amount of current transported depends on the amount of asphaltenes dissolved
- No detailed explanation of charge origin can be given so far



# Acknowledgements

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**Thank you!**