Capillary Electrophoresis on Unconventional Fluids

Presented By

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Agenda

- Introduction
- Theories
- Experiments
- Conclusions
- Acknowledgement

Introduction

- The supply of conventional oil is fading, thus the world is dependent more and more upon unconventional resources
- Asphaltenes--as one of the unconventional resources, their interactions with environment is complicated which impact all aspects of their utilization
- A better understanding of the properties of asphaltenes is essential
- The objective is to separate asphaltene polar fractions according to their electric charge and size via a microfluidic device and analyze them

Introduction

Microfluidic device

- 4 reservoirs
- Cross channels which are 5-10μm deep
- Fabricated by borosilicate glass
- Channel walls are originally negatively charged

Theories

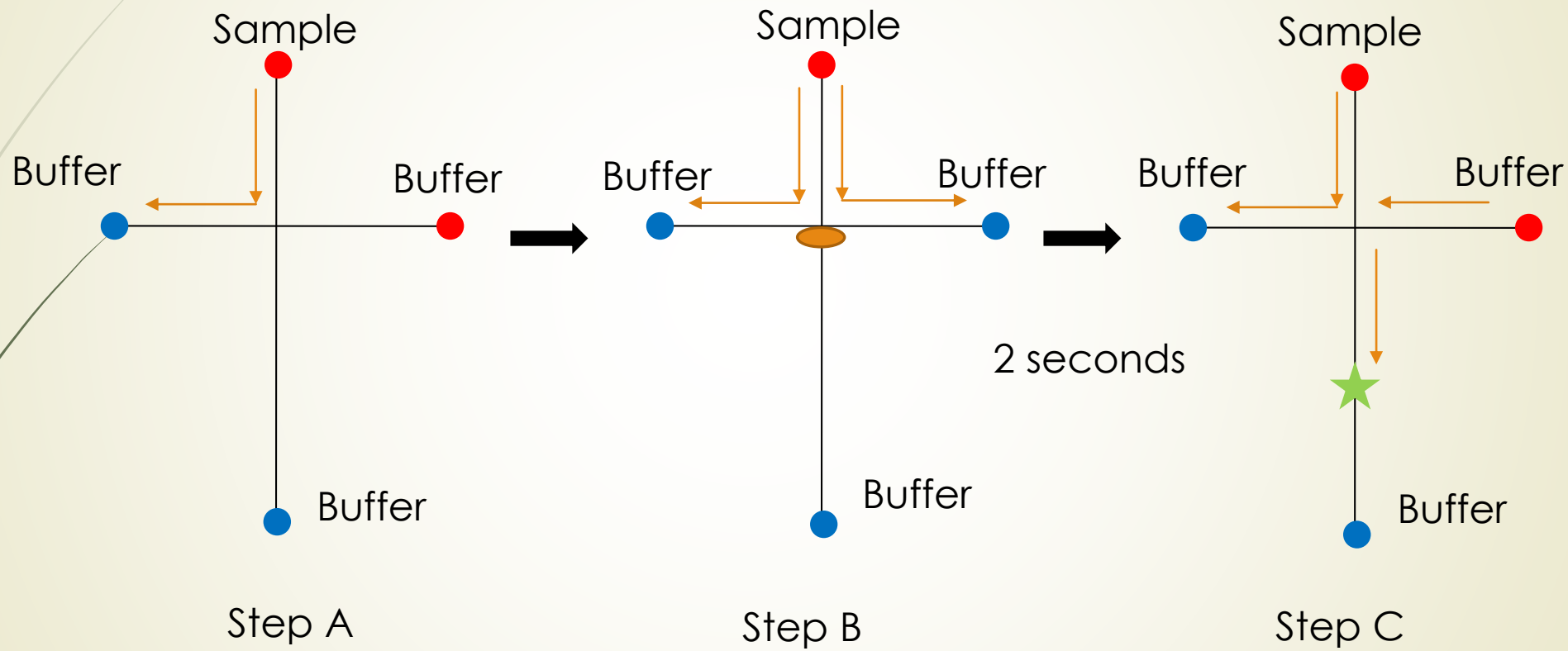
Electrophoresis flow

- The motion of ionic species induced by an electric field in a conductive fluid medium.
- The direction of the flow can be varied by the different charges on the ionic species.

Electroosmotic flow

- The motion of liquid induced by an applied potential across a porous material, capillary tube, membrane, microchannel, or any other fluid conduit.
- As long as the potential stays the same, the direction of this flow stays the same.

Theories



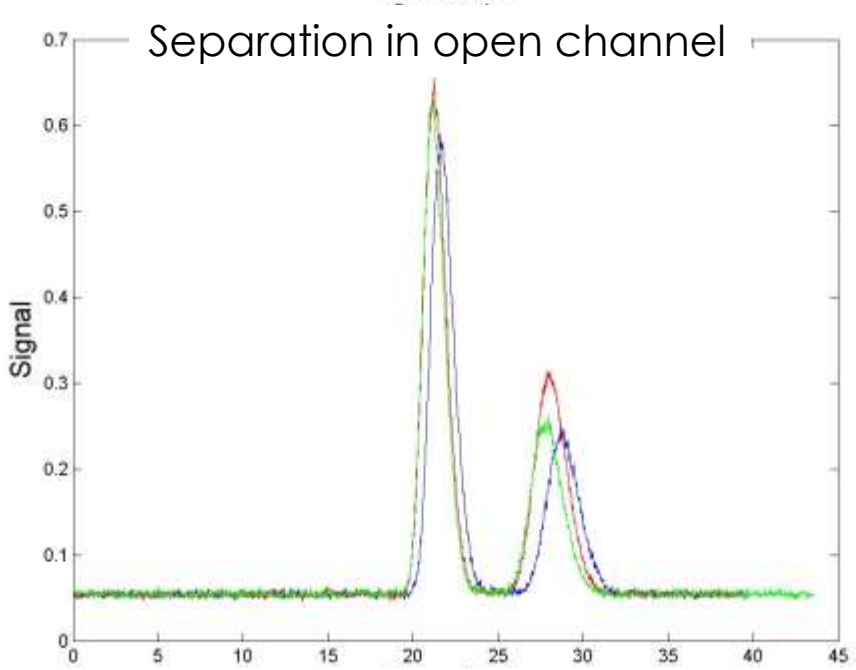
- Ground or low voltage
- High voltage

Experiment

Separation of resorufin and Rhodamine B

- resorufin: negatively charged Rhodamine B: positively charged
- Resolution (Separate efficiency)

	600V	900V	1200V	1500V
Open channel	2.17	2.05	1.91	1.78


Separation in open channel
Signal
0.7
0.6
0.5
0.4
0.3
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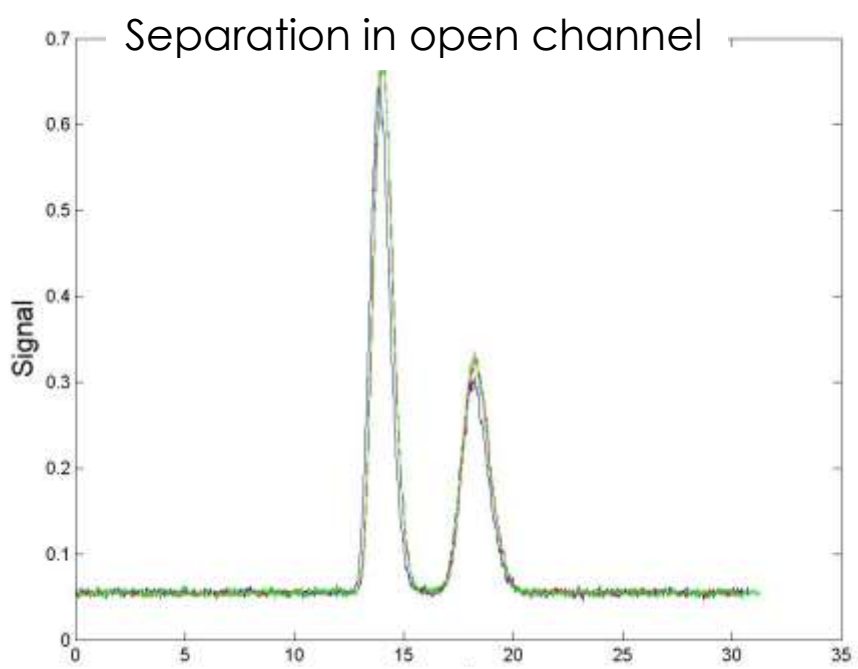
0 5 10 15 20 25 30 35 40 45


Separation in open channel
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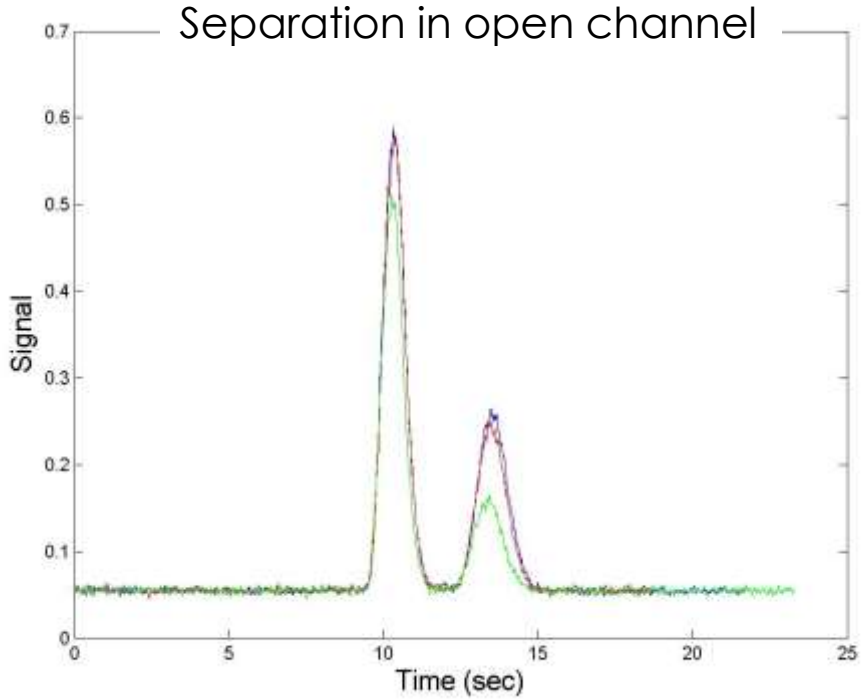
Separation in open channel
Signal
0.7
0.6
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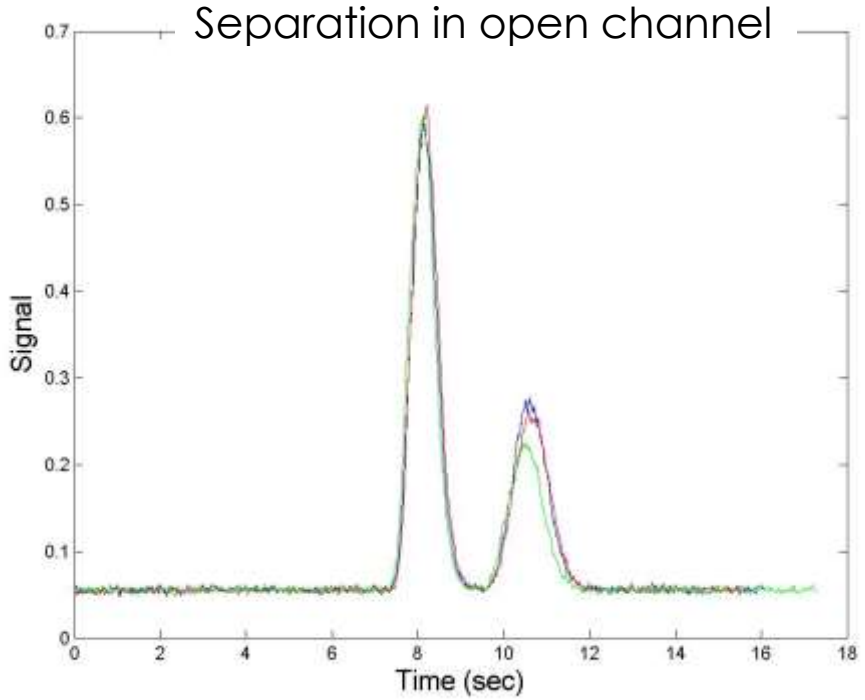
0 5 10 15 20 25
Time (sec)


Separation in open channel
Signal
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 2 4 6 8 10 12 14 16 18
Time (sec)

Experiment

Injection and separation of asphaltenes

- Preparation of asphaltene sample is achieved by dissolving 0.001g asphaltene in 0.05mL toluene and mixing with 0.5mL acetonitrile.
- Buffer used in previous experiment has to be changed to organic solvents due to the fact that asphaltene dissolves only in organic chemicals
  - toluene: acetonitrile(80:20)

Experiment

Injection and separation of asphaltenes

- Detection of the asphaltene sample is difficult due to its poor fluorescence property
- The sample moves at a very low speed due to the low dielectric constant of the sample
- The sample sometimes stop moving after running for a while
- It was observed that the sample started moving in an opposite direction after it stop moving for a while

Experiment

- Another device called microfluidic continuous electrophoretic device was suggested and experiments were operated by one graduate student in Dr. Dutta's lab.
- The separation cannot be achieved for some reasons

Conclusions

- Separation of asphaltenes was not achieved due to following reasons
  - Low dielectric constant
  - Poor fluorescence property
  - Positive charges in asphaltenes neutralized the negative charges on the surface of channels
  - Sample and buffer are volatile

Acknowledgement

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Questions?

Thank You!