# Surfactants on Oil/Water interface studied by modified Scheludko-cell

**Maryam Razi *[1], Behnam Sadri[2], Mohtada Sadrzadeh *[3], Thomas Thundat [1]**

*[1] Department of Chemical and Materials Engineering, University of Alberta, Edmonton,AB, T6G 1H9, Canada; [2] School of Mechanical Engineering, Purdue University, 585 Purdue Mall, West Lafayette, IN 47907-2088, [3] Department of Mechanical Engineering, University of Alberta, Edmonton, AB, T6G 1H9, Canada* mrazi@ualberta.ca, sadrzade@ualberta.ca

XVI World Water Congress
International Water Resources Association (IWRA)
Cancun, Quintana Roo. Mexico. 29 May- 3 June, 2017

UNIVERSITY OF ALBERTA

## Introduction

➢ **Thin Liquid Films (TLFs)**

- ❖ TLFs, formed by the continuous phase (the dispersion medium), are central to colloid science and have vast practical (technological and environmental) importance.
- ❖ TLFs are basic structural element of various dispersed systems widely spread in nature, including foam and emulsions.
- ❖ Through knowledge of the formation and stability of these intervening films gives enough information regarding the formation and stability of different emulsion systems.

## Objectives

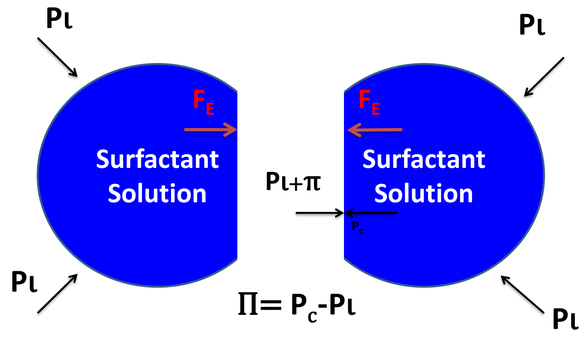
- ❖ The main objectives of this work are to develop experimental techniques for:
- ❑ Exploring possibility of developing new technique for real time analysis of film formation and its stability
- ❑ Exploring possibility of developing a technique for film formation detection at nanoscale

## Background

### O/W Emulsion Separation

➢ **Thin Liquid Films (TLFs)**

- ❑ TLF dynamics is the cornerstone of emulsion stability.
- ❑ Control on emulsion stability is of interest in industry.
- ❑ For instance, in Steam Assisted Gravity Drainage (SAGD), an in-situ oil sands operation, the extracted produced water (PW) is composed of water as the continuous phase, oil droplets which are dispersed in water, clay particles and dissolved organic matter (DOM).
- ❑ Measurement techniques for assessing emulsion stability is vital for controlling the stability of the emulsion.
- ❑ As emulsions are composed of one phase dispersed within another, its overall stability relies on the stability of the individual films of intervening continuous phase that separate the disperse phases.
- ❑ To stabilize the TLF, the presence of surfactants are necessary. SDS has been used in this work as surfactant in aqueous medium.

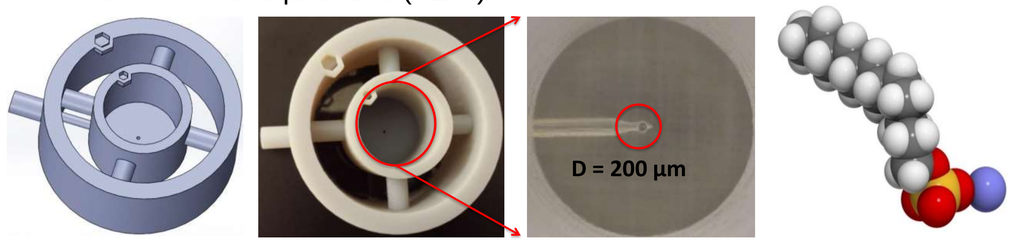



- ❑ The concept of Force Balance and disjoining pressure in TLFs

## Design Concept and Fabrication

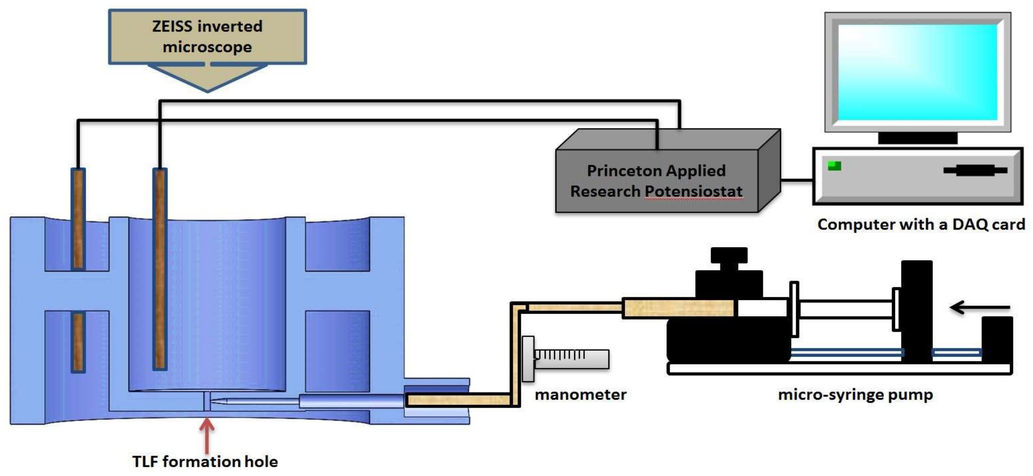
### 3D-Printed Designed Modified Scheludco-Cell (MSC)

- We used 3D-printing technology to fabricate a microfluidic cell to study the formation of Thin liquid films (TLFs)



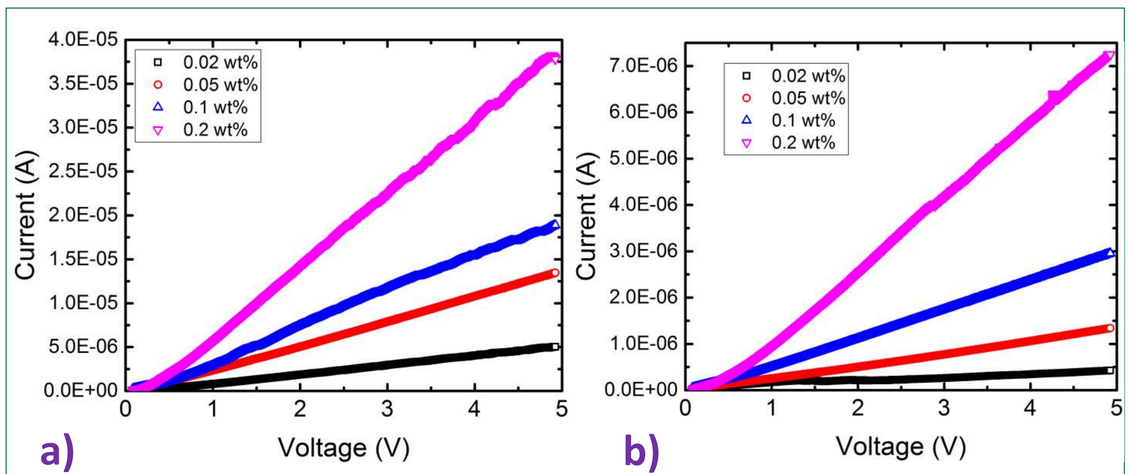

- The MSC which has been designed using 3D CAD design software has been 3D-printed using Form2 3D-printer, using GPCL02 resin material

## Experimental Setup



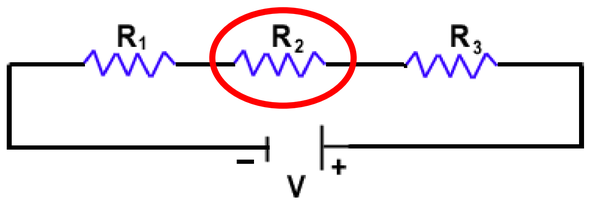

❖ The MSC is filled with the surfactant solution and using the syringe pump and Hamilton micro-syringe, the oil phase is injected into the system. The electrodes are applied in the cell in such a manner that they have the same height inserted in the upper and lower surfactant aqueous phase. The electrical conductance of the system is monitored using the Princeton Applied Research Potensiostat/ Galvanostat. Oil-phase TLF formation is then detected using the system resistance measurement.

## Results

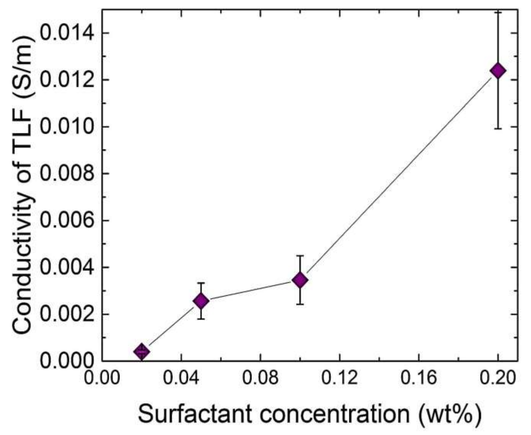



❖ Current vs Voltage curve for the system composed of different SDS concentrations in milli-Q water as aqueous phase and n-dodecane as oil phase (TLF phase). a) Without formation of TLF. b) With formation of TLF of n-dodecane and reduction in the slope of the Current vs Voltage curve.

❖ We hypothesize that this increase in resistance of the system is caused by the formation of another resistance in the system which we considered as the **TLF resistance**.

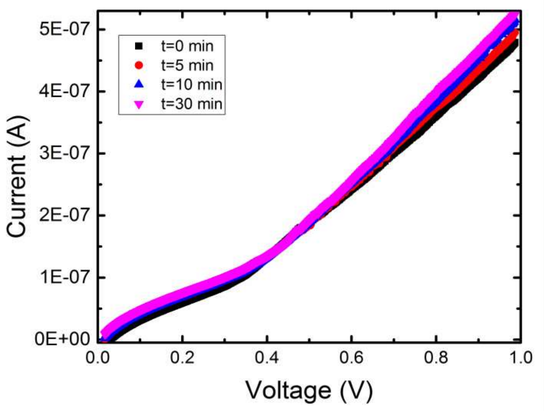



## Results




❑ **Effect of different surfactant concentration on TLF conductivity (S/m)**

➢ The concentrations of surfactants are (0.02, 0.05, 0.1, 0.2 wt% of SDS in milli-Q water)




❑ **Adsorption dynamics of SDS surfactants at Oil-Water interface studied using our novel 3D-printed MSC**

## Conclusion

- In this study, a novel 3D-printed modified Scheludko-cell (MSC) has been used.
- An electrical modelling treatment for **O/W interface** has been done using resistors in series. Current vs voltage curve for the system composed of different SDS in milli-Q water as aqueous phase and n-dodecane as oil phase (TLF phase) has been obtained using the 3D-printed modified Scheludko-cell.
- we examined the effects of surfactants adsorption dynamics on TLF electrical behavior.
- Effect of different surfactant concentration on TLF conductivity (S/m) has been monitored and it was concluded that by increasing surfactant concentration, TLF conductivity has been increased.

## Acknowledgment

Canada Excellence Research Chairs
Chaires d'excellence en recherche du Canada
AWRL ADVANCED WATER RESEARCH LAB | UNIVERSITY OF ALBERTA
ConocoPhillips
SUNCOR ENERGY
devon