FUTURE WORK

There are many factors that should be taken in account when to use the EW principle in oil water separation. One of the important factors is the selection of the material for the electrode coating, since it will affect the wettability. Also, the design of the system that will be studied to predict control of the contact angle should be given careful precautions. There are three possible steps to consider when trying implementing EW in water oil separation.

First, the behavior of water droplets in a static test should be studied, where voltage may be applied with the presence of static water droplets. Second, the behavior of the water droplets when we have a flow stream of oil and water droplets mixed together. Third, the prober design of the filter media may be found after conducting the previous mentioned steps. Finally, the performance of the filter media can be tested.

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$$\cos\theta = \frac{(\gamma_{s\beta} - \gamma_{s\alpha})}{\gamma_{\alpha\beta}} + \frac{1}{2\gamma_{\alpha\beta}} \frac{\epsilon_0\epsilon}{d} V^2 \quad (2)$$

where ε is the dielectric constant, d is the thickness of dielectric, and V is the applied voltage.

The ability of a water droplet to freely wet the surface being studied is controlled by interfacial tension between the water droplet and the surface. If the contact angle can be changed by introducing the electric field, then that will allow controlling wettability.

EXPERIMENTAL RESULTS

To study the relationship between the contact angle and the applied voltage, there are two electrode setups. The first one is the coplanar electrode setup where the droplet sits on the dielectric insulation [3]. The second one is where the electrode is below the droplet and the droplet is grounded [4].

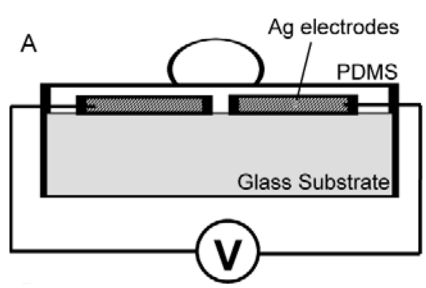

Figure1. The first electrode setup [3].

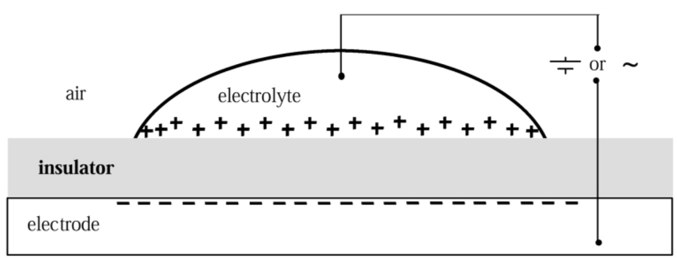

Figure2. The second electrode setup [4].

It has been reported in the literature [5] that the contact angle of water droplet (de-ionized water) was changed from 126^o to 81^o when 28 volt has been introduced in coplanar electrodes. The electrodes were fabricated on an Au/Ti-coated glass substrate (Evaporated Metal Films, NY).

According to the above theory and experimental results, water droplets are expected to deform when there is an applied electric field. This deformation causes the contact angle to change and consequently, wettability changes. That will be the key point of implementing EW in coalescence filtration.

Control of droplet contact angle via Electrowetting

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The contact angle between a drop and a surface directly controls the wettability of the drop to the surface and the motion of the drop along a surface. The contact angle is often used to determine the interfacial tension of the drop as the interfacial tension force is balanced by gravitational force.

A recently developed method of electrowetting changes the contact angle of the drop without changing the interfacial tension. The addition of electrical forces to the drop require the contact angle to change for the forces to balance. The resulting performance of the drop in contact with a flat surface is similar to one having a lesser surface tension and the drops tend to wet and stick to the surface.

This technology has potential in oil-water separations. Separators can collect drops and periodically the electric field turned off to allow the drops to drain out. This paper presents the background of the technology and a brief discussion of a research project to explore its potential use in oil-water separations.

INTRODUCTION

Separation of water from oil in the water in-oil- emulsion is an important task in petrochemical industry. Many methods and techniques have been used to perform this task. However, there is a potential technique that could be implemented to even separate fine particles of 100 microns and less. The technique is called Electrowetting (EW) which has a potential use in coalescence filtration.

Electrowetting is the modification of a hydrophobic surface to a hydrophilic surface by introducing electric field. This gives the ability to control the wetting property of a surface for a specific the desired purpose. Since liquid- liquid coalescence is largely dependent on wettability, EW may give a breakthrough in coalescence filtration.

THEORETICAL BACKGROUND

Surface tension for water droplet can be described by Yong's equation. Yong's equation takes different forms, which can describe different geometries. For water droplet it can take the following form [1].

$$\cos\theta_0 = \frac{\gamma_{sg} - \gamma_{sl}}{\gamma_{lg}} \qquad (1)$$

where γ_{ij} is the surface tension, and subscripts sag and l are different phases. θ_0 is the contact angle.

If there is a potential difference applied, then the interfacial tension of a droplet and a surface can be related by Lippmann-Young equation as follows [2].