Investigating the Stability of Interfacial Films in Crude Oil Emulsions by Light Transmission through Gold Nanoholes

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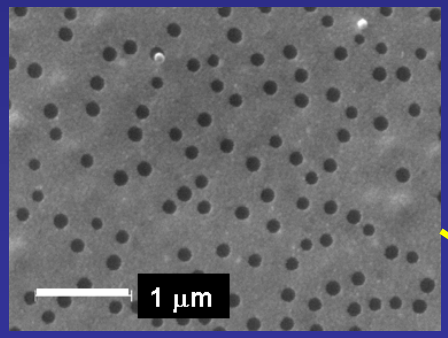
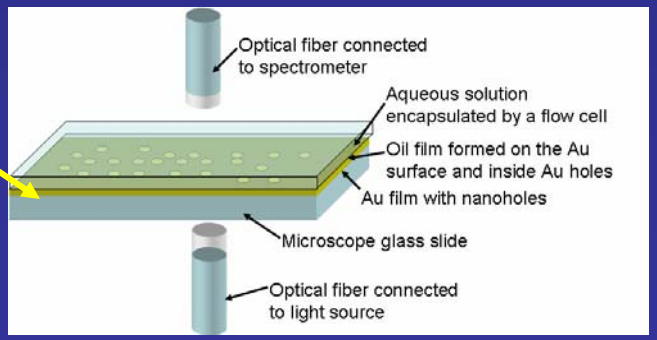
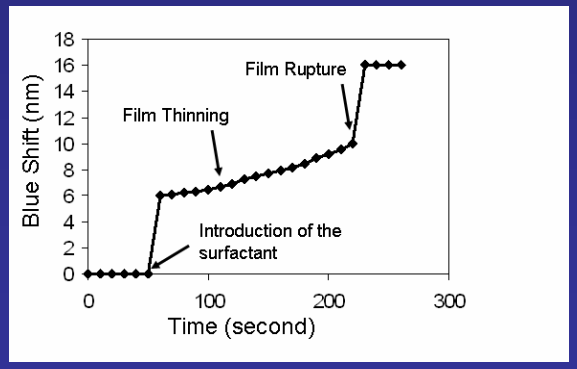
The stability of interfacial films between crude oil and water plays an important role in the demulsification process and determines the efficiency of oil recovery. The mechanisms for breaking the water-oil interfacial films are complicated due to the nature of the process and the complex constituents of the crude oil. We propose to use devices consisting of gold nanoholes (120 nm in diameter) to investigate the mechanisms for breaking the interfacial films formed inside the holes by measuring the light transmission spectrum through the gold holes. Thinning and rupturing of the interfacial films lead to changes in the refractive index of the medium inside the gold holes, which result in detectable wavelength-shifts of the localized surface plasmon resonance peak in the transmission spectrum originated from the gold nanoholes. Using this approach, we will monitor the thinning and rupturing processes of the interfacial films in crude oil emulsions and investigate their mechanisms during the demulsification process at various conditions, and study the influence of the natural constituents in crude oil and chemical demulsifiers on these processes. The breakdown procedure of the interfacial films at each operating condition will be ascribed to one of the three hypothesized mechanisms. The investigation will contribute to our fundamental understanding of the stability of interfacial films in crude oil emulsions. This approach could also be developed into a platform for investigation of other types of interfacial films for a variety of applications from petroleum industry to high-tech fields of biotechnologies.



Au nanoholes





Optical signals