LIGHT SCATTERING STUDY OF ADSORPTION OF SURFACTANT MOLECULES AT OIL–WATER INTERFACE

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We have studied the following two types of oil–water interfaces by light scattering techniques:

a) Flat Interfaces

Interfacial tension has been deduced from the spectrum of the light scattered by the interface. The results are relative to water–toluene–sodium dodecyl sulfate (SDS)–butanol mixtures either in the two phase, or in the three phase region of the phase diagram. Values down to $10^{-3}$ dynes/cm have been measured. Measurements down to $10^{-5}$ – $10^{-6}$ dynes/cm are expected to be achievable with this technique.

b) Microemulsions

The intensity and the autocorrelation function of light scattered by a microemulsion have been investigated for the water in oil type microemulsions. We studied two mixtures: water–SDS–cyclohexane–pentanol and water–SDS–toluene–butanol. We obtain information about droplet size (radius of the aqueous core, hydrodynamic radius) and about interaction forces between the droplets (from osmotic compressibility and diffusion coefficient data). The role of the nature of oil and the influence of salt on these parameters is also discussed.
INTRODUCTION

The adsorption of surfactant molecules at oil-water interfaces has attracted much interest, in relation to the oil recovery techniques (1). The systems containing oil, water and emulsifier molecules form generally two phases: an aqueous phase containing sometimes solubilized oil in the form of small droplets surrounded by emulsifier molecules and an oil phase which also can contain solubilized water. When the amount of emulsifier is large enough, the system can form only one phase, i.e. all the water (or oil) can be solubilized in the oil (or water). The system is again a dispersion of very small droplets of water (or oil), surrounded by emulsifier molecules, in a continuous medium containing the oil (or water). Such dispersions are currently called microemulsions. The droplet size is usually of the order of 100 Å (2).

A very schematic phase diagram showing single and two phase regions is represented by Figure 1(a). Figure 1(b) shows a situation where the system forms three phases. The lower phase is usually pure water, the upper phase pure oil, and the middle phase is thought to be a microemulsion containing most of the emulsifiers.

The interfacial tensions in the two phase region are generally small (1-10^{-2} dynes/cm) and even smaller in the three phase region (10^{-3}-10^{-4} dynes/cm). These properties are expected to be related to the structure of the microemulsions in the bulk phases (3).

Light scattering techniques are useful tools to investigate both interfacial properties such as surface tension and viscoelasticity (4) and bulk properties such as droplet size and interaction forces between these droplets (5,6). It must be pointed out that in each case, light is probing thermal fluctuations in the medium but the fluctuations are of a very different nature: surface roughness in the first case, and droplet concentration fluctuations in the case of bulk scattering.

Fig. 1. Schematic phase diagram