Emulsion film properties as studied by interferometry

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A thin liquid foam or emulsion film spontaneously arises at the contact between two foam bubbles or emulsion droplets, respectively. The stability and properties of foam and emulsion films determine largely those of the overall foam and emulsion systems.

Based on the ‘disjoining’ pressure concept \cite{1}, the Thin Liquid Film – Pressure Balance Technique (TLF-PBT) \cite{2} has been established in studying the interaction forces between bubbles and droplets. By this method, kinetic and thermodynamic properties of single microscopic plane-parallel liquid films are studied. The so-called ‘equivalent’ thickness is measured interferometrically with an accuracy of less than 1 nm \cite{2}. Thus, TLF-PBT provides direct measurements of the film disjoining pressure vs. film thickness dependence (disjoining pressure isotherm), i.e. the TLF interaction forces. A number of emulsion film characteristics such as disjoining pressure isotherm, rate of film drainage, critical thickness and pressure of film rupture, film lifetime, contact angle etc. can be measured by this technique and further correlated with emulsion’s stability and properties such as emulsification ability, droplet-size distribution, rate of coalescence, Ostwald ripening etc.

TLF stability and properties are intrinsically related to the characteristics of the adsorption layers at film surfaces. For instance electrical double-layer forces in a TLF originate from the interfacial charge \cite{3}, which can be modified by the adsorption layer composition; the action of steric forces is related to adsorption of macromolecules and their surface conformation \cite{4}; the rate of film drainage is strongly affected by the rheological properties of the film surfaces etc. Thus, along with emulsion film studies, investigations on the corresponding oil/water interfacial layers could greatly contribute to the general understanding of emulsion systems.

References