357b Measurement of Lipid and Protein Adsorption to the Air-Water Interface Using Quantitative Brewster Angle Microscopy

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Conventional techniques for measuring surface density of molecules at the air-water interface, such as surface pressure, fluorescence light microscopy (FLM) and scanning force miscropy (SFM), suffer from artifacts, are limited in scope, and are likely to influence the system being measured. We describe the use of quantitative Brewster angle microscopy (BAM) to measure surface density which uses no fluorescent probes, requires no transfer of films to a solid substrate, and allows visualization of nonuniform monolayer domains of surfactants. BAM uses p-polarized light incident at the Brewster angle of the subphase, where reflectivity R is ideally zero. Addition of a thin film to the surface with a different index of refraction than the subphase will reflect a small amount of the incident light. A simple optical model based on Fresnel's equations allows the measurement of the index of refraction of the surfactant film, which is linearly related to surface density. We confirmed the validity of quantitative BAM by comparing our refractive index measurements to lipid systems of known surface density. We use BAM to measure adsorption rates of proteins as a function of surface pressure predicted by our theory of protein adsorption based on the classical Smoluchowski model of colloid aggregation.