

# Nanoscopic Foam Films: correlating molecular structure with surface forces

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A novel spectroscopic approach is introduced to investigate the molecular structure and surface forces in thin foam films, which are essential components of macroscopic foams and model systems for confined liquids. By integrating UV-visible, infrared, and Raman spectroscopies with a thin film pressure balance, the water core thickness is directly quantified, and surfactant adsorption behaviour is analysed without relying on correction models. Specifically, foam films stabilized by alkyl trimethyl ammonium surfactants are systematically examined to assess the effects of the halide counterions ( $\text{Br}^-$ ,  $\text{Cl}^-$ ,  $\text{F}^-$ ) and alkyl chain length ( $\text{C}_{12}$ ,  $\text{C}_{14}$ ,  $\text{C}_{16}$ ). The findings reveal that while the adsorbed amounts and molecular orientation remain independent of the disjoining pressure, anion identity plays a significant role in the surfactant behaviour. The binding affinity follows the order  $\text{Br}^- > \text{Cl}^- > \text{F}^-$ , in agreement with Collins' rule of matching water affinities. This methodology advances the characterization of ultra-thin liquid films, improving the precision of structural analysis and providing new and deeper insights into confined systems and surface interactions.