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Bubbles, surfactants, shape oscillations, optical levitation, and light scattering: a survey

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Research emphasizing relatively slow aspects of bubble dynamics will be summarized. Though the attention is mainly on acoustically levitated bubbles larger than the size for monopole resonance, early experiments on stable optical levitation of gas bubbles in water [J. Acoust. Soc. Am. 83, 970-975 (1988)] will also be noted as well as fundamental aspects of light scattering by bubbles [J. Opt. Soc. Am. and/or Applied Optics (1979-1991)]. Modulated radiation pressure was demonstrated to be an effective way for mode-specific excitation of shape oscillations of acoustically levitated bubbles [J. Acoust. Soc. Am. 93, 706-713 (1993)]. The damping of shape oscillations was demonstrated to be strongly influenced by the presence of insoluble or soluble surfactants [J. Fluid Mech. 300, 149-167 (1995); Phys. Rev. Let. 75, 2686-2689 (1995); J. Acoust. Soc. Am. 102, 3372-3377 (1997)]. A convenient way of measuring the damping was to use laser beam extinction to monitor freely decaying shape oscillations. This technique was sufficiently sensitive to reveal the strong dependence of the damping on surface elasticity. Even for clean bubbles, an improved analysis of the damping was needed. [Sponsored in part by NASA and by ONR.]