Master's Thesis Defense
Electro-Optics and Photonics
Wednesday, May 1, 2019, 11 a.m., Fitz Hall 580
All are welcome to attend

Dynamics of laser-induced 3D microbubbles in an absorbing liquid

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Abstract

Optical trapping and manipulation of microbubbles in a liquid can be used in precise drug delivery and other biological applications. In this work, the generation and subsequent dynamics of a microbubble in a liquid are investigated, both experimentally and theoretically. When a laser beam is focused into an absorbing liquid comprising colloidal red dye particles in isopropanol alcohol, microbubbles can be generated at around the focus due to nucleation and thermal cavitation. It is experimentally shown that in some cases, the generated microbubble initially moves away from the focus due to the longitudinal optical gradient force, and is later attracted towards the focus due to the longitudinal thermo-capillary force. The thermo-capillary force on the microbubble is determined first by solving the longitudinal and transverse heat equations separately, and then by directly solving the 3D heat equation by 3D Fourier transform methods. When developing the complete force model in microbubble movement, the thermo-capillary force, optical force, buoyancy force, gravity, and viscous force have been considered.