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Radiation Pressure Induced Nonlinear Optofluidics in Liquid Droplets[1] PENG ZHANG, SUNGHWAN JUNG, Department of Biomedical Engineering and Mechanics, Virginia Tech, Blacksburg, VA 24060, YONG XU, ARAM LEE, Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA 24060 — In the present study, we analyze a nonlinear optofluidic process associated with a high quality (Q) factor whispering gallery mode (WGM) in liquid droplets. Optical radiation pressure induced droplet deformation can produce a frequency shift proportional to the WGM power. Droplet deformation will be obtained both theoretically and numerically by boundary element method. We will show that the nonlinear optofluidic effect is stronger than temperature-induced nonlinearity. Using liquid properties that are experimentally attainable (e.g., oil drop in water), we find that measurable WGM resonance shift may be generated by only a few photons. This technique may also lead to the possibility of fluid viscosity and interfacial tension measurement by non-destructive optical forces.

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