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Liquid droplet whispering-gallery mode optical resonators

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Over the last decade, optical whispering-gallery modes (WGMs) have been observed in solid micro-cavities of various geometries. WGMs supported by dielectric microspheres and toroids exhibit an optical field that is confined near to the surface. The interaction with chemical species may occur through the modification of the optical environment of the resonator if the internal field is exposed along the cavity-medium interface. For example, if interacting molecules exhibit optical absorption features at the operating wavelength; the lifetime of photons within the cavity is reduced. Silica resonators proved ultra-sensitive bio-chemical probes but were also studied as miniature systems to observe coupling and interaction phenomena between light and matter. Here, we propose to use liquid droplets as micro-resonators for sensing applications. The droplet itself serves as the sensor and the sample at the same time, where the internal optical field is directly used to probe dissolved analytes or particles. We demonstrate free-space laser excitation of whispering-gallery modes in vertically-suspended mm-size oil droplets. Laser frequency locking on resonant modes and cavity lifetime measurements are performed recording Q-factors of 5×10^5 . Appealing applications for spectroscopy, material characterization and non-linear optics are envisaged.

Biography

Gianluca Gagliardi is a staff Scientist at CNR-National Institute of Optics (INO) in Naples, Italy, since 2003. His activity has been focused on laser spectroscopy, non-linear optical generation systems, optical-comb synthesizers and fiber-optic sensors. At INO, he is the Head of the "Optical Sensors" laboratory where the main themes are: Optical fiber gratings and resonators for mechanical, inertial and chemical sensing. He has authored more than 50 papers in international refereed journals and more than 80 conference contributions at conferences and meetings. He's been responsible for long-term international cooperation programs between Italian CNR and India (CSIR), Czech Republic (IPE), Canada (Queen's University) and USA (Berkeley).

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