SMU Department of Mechanical Engineering

Seminar

Whispering Gallery Mode-Based Micro-Optical Sensors for Aerospace Applications

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J. Lindsey Embrey Building

Abstract: The so-called whispering gallery mode (WGM) optical phenomenon of dielectric micro-spheres has received significant attention in recent years and several applications have been proposed that use this phenomenon. In these proposed applications, ranging from optical switching and filtering (for telecommunication) to chemical and biological sensing, the morphology dependent shifts of these optical modes (WGMs) are exploited. Any change in the environment surrounding the dielectric sphere induces a shift in the WGMs. A remarkable feature of WGMs of micro-spheres is their extremely large Q values (reaching ~ 10^9 for silica spheres) which raises the potential for high-sensitivity measurements. In this research, the development of WGM sensors for aerospace applications is explored. One particular interests is the development of a WGM-based micro-optical force and wall shear stress sensor. The work includes a basic study (both experimental and analysis) investigating the force sensitivity and range of micro-sensors of several different materials and geometries followed by the wall shear stress sensor design, testing, and characterization. Since, in flow measurements, other effects such as pressure, temperature, gas composition, can be encountered, those effects might interfere with the proper functioning of the sensor, adding uncertainty in measurements. The study addresses some of the issues, in particular, the effect of pressure and the composition of the fluid surrounding the sensor.