Unsteady Wall Shear Stress Measurements Using a Polymeric Microsphere-Based Optical Sensor\textsuperscript{1} ULAS AYAZ\textsuperscript{2}, TINDARO IOPPOLO\textsuperscript{3}, VOLKAN OTUGEN\textsuperscript{4}, Southern Methodist University — The performance of a micro-optical wall shear stress sensor based on the whispering gallery modes (WGM) of dielectric microspheres is investigated in an unsteady flow. The sensing element is a polymeric microsphere of several hundred microns. The shear force acting on a movable plate which is flush with the wall is mechanically transmitted to the microsphere. The transmitted force perturbs the sphere’s shape and refractive index leading to a shift in the optical resonances of the sphere (WGM). By monitoring these shifts, the shear force acting on the wall is measured. Unsteady wall shear stress measurements are made in a plane acoustic wave tube to investigate the bandwidth and sensitivity of the sensor prototype. By using Polydimethyldisiloxane (PDMS) spheres, shear stress resolutions of \(\sim 10^{-2}\) Pa have been measured experimentally.

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