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Unsteady Wall Shear Stress Measurements Using a Polymeric Microsphere-Based Optical Sensor[1] ULAS AYAZ[2], TINDARO IOPPOLO[3], VOLKAN OTUGEN[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 Polydimethylsyloxane (PDMS) spheres, shear stress resolutions of $\sim 10^{-2}$ Pa have been measured experimentally.

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