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High-speed Tracking of Quantum Dots in Microflows using Evanescent Wave Illumination JEFFREY GUASTO, KENNETH BREUER, Brown University — Total internal reflection velocimetry (TIRV) is applied to measure the dynamics of colloidal quantum dot (QD) tracer particles within 200 nm of a microchannel wall at shear rates in excess of 20,000 s^{-1}. QDs are quickly developing into viable tracer particles for measuring microscale fluid dynamics. However, the low emission intensities of QDs usually require long exposure and inter-frame times, which limit velocity resolution and compromise accuracy (due to their fast diffusion as a consequence of a small, 17 nm hydrodynamic diameter). In this study, a two-stage, high-speed image intensifier and camera were integrated into an evanescent wave microscopy imaging system to provide the necessary high temporal resolution to image the fast diffusion dynamics of QD's in real time (up to 10,000 fps), which allowed individual particles to be tracked continuously for extended periods. In addition to examining the trajectories of individual particles, ensemble-averaged tracking measurements reveal near-wall velocity distributions in high-speed microchannel flows (Re$\sim$10), where velocities on the order of 5 mm/s are measured within 200 nm of the microchannel wall. This data provides a robust confirmation of recent results demonstrating diffusion-induced bias error for near-wall velocimetry.

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