Abstract Submitted
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Fluorescence thermometry measurements of wall surface and bulk fluid temperatures[1] MYEONGSUB KIM, MINAMI YODA, Georgia Institute of Technology — Measuring fluid temperature fields at micron-scale spatial resolution is of interest in applications including microelectronic cooling and microfluidics. Fluorescence thermometry (FT), where temperatures are estimated from variations in the emission intensity of various fluorophores, is commonly used to measure liquid temperatures in a variety of flows. Here dual-tracer FT (DFT) where fluorescein (Fl) and sulforhodamine B were volumetrically illuminated was used to measure temperature fields in the Poiseuille flow of water through a heated 1 mm square channel. The average experimental uncertainties in the DFT results are estimated to be <0.3 $^\circ$C at a spatial resolution of 30 μm in the image plane at $Re = 3.3$ and 8.3. Evanescent-wave FT (EFT) where only Fl is illuminated by evanescent waves was also used to measure the liquid-phase temperature field within the first 0.3 μm next to the wall with an average uncertainty of <0.2 $^\circ$C at a resolution of 10 μm. Comparison with numerical predictions show that the EFT results are effectively the wall surface temperature. Comparison of the DFT data with numerical predictions suggest that the spatial resolution of these data along the optical axis is at least an order of magnitude greater than the depth of field.

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