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Convective Heat-Transfer Characteristics of Laminar Flow Through Smooth- and Rough-Wall Microchannels V.K. NATRAJAN, K.T. CHRISTENSEN, University of Illinois, Urbana — The convective heat-transfer behavior of laminar flow through smooth- and rough-wall microchannels is investigated by performing *non-intrusive* measurements of fluid temperature using a microscale adaptation of two-color laser-induced fluorescent thermometry for flow through a heated copper microchannel testbed of hydraulic diameter $D_h = 600\,\mu$m. These measurements, in concert with pressure-drop measurements, are performed for a smooth-wall case and two different rough-wall cases with roughness that is reminiscent of the surface irregularities one might encounter due to imperfect fabrication methods. Pressure-drop measurements reveal the onset of transition above $\mathrm{Re}_{\mathrm{cr}} = 1800$ for the smooth-wall case and deviation from laminar behavior at progressively lower Re with increasing surface roughness. The local Nusselt number (Nu) for smooth-wall flow over the range $200 \leq \mathrm{Re} \leq \mathrm{Re}_{\mathrm{cr}}$ agree well with macroscale predictions in both the thermally-developing and -developed regimes. With increasing roughness, while an enhancement in local Nu is noted in the thermally-developing regime, these differences do not exist upon attainment of a thermally- developed state. Examination of temperature profiles across the microchannel suggest that the thermal boundary layer may be regenerated by roughness, resulting in a delay in the attainment of thermally-developed flow.

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