Abstract

A combined experimental and numerical investigation is carried out to study the characteristics of laminar flow and forced convection heat transfer in a square cross-section wavy “serpentine” microchannel with the upper wall insulated and other side walls held at constant temperature. Experimental measurements of convective heat transfer and pressure drop are performed for 30/70% and 10/90% by weight mixtures of glycerine/water over a range of Dean number from 0.6 to 80. Complementary three-dimensional computational fluid dynamics numerical simulations are also conducted for the same conditions. The results show that the growth of secondary-flow vortices promotes fluid mixing in the [serpentine](https://www.sciencedirect.com/topics/chemical-engineering/serpentine) microchannel and leads to an enhancement of the convective heat transfer. As a consequence the serpentine microchannel is able to enhance the performance of heat transfer relative to a straight microchannel over the entire range of Dean number. Meanwhile, at these values of Prandtl number the relative pressure-drop losses increase with increasing Dean number. These increased pressure-drop losses are rather modest over the whole range of Dean number compared with the significant enhancement in heat transfer.