ABSTRACT

In this paper, a PCM fluid is compared with pure water as heat transfer fluid. The heat transfer behavior of phase change material fluid (PCM) under laminar flow conditions in circular and rectangular microchannels was studied numerically. As part of the numerical study, an effective specific heat technique was used to model the phase change process. Heat transfer results for smooth circular and rectangular microchannels with PCM fluid were obtained under hydrodynamically and thermally fully developed conditions. A PCM fluid in microchannels with different aspect ratios was found to exhibit unique thermal behavior which could be beneficial in electronic cooling applications.

As a part of boundary conditions, the flow was assumed to be hydrodynamically fully developed at the inlet and thermally developing inside the microchannel. Heat transfer characteristics of PCM slurry flow in microchannels of various aspect ratios have been studied under three types of wall boundary conditions including constant axial heat flux with constant peripheral temperature (H1), constant heat flux with variable peripheral temperature (H2), and constant wall temperature (T) boundary condition. Effects of phase change on the heat transfer were determined using a specific heat model, which includes the effect of latent heat of fusion of the phase change material. The fully developed Nusselt number was found to be higher for H1 than for H2 and T boundary conditions for all the geometries.