Hydrothermal Performance Maximisation and Entropy Generation Minimisation of Different Perforated Pinned Heat Sink Designs for Electronic Cooling

To quantify the benefits of reducing entropy production and improving hydrothermal performance with varied thermal air characteristics through different perforated heat sinks, a numerical study was conducted. Various numbers of circular perforations are studied from 0 perforations to 5 perforations. In addition, perforation configuration is considered, such as circular (3CP), square (3SP), elliptic (3EP), and triangular (3TP) perforated pinned heat sinks, as well as three slotted pinned heat sinks (SPHSs) (3S, 6S, and 10S) and four notched pinned heat sinks (NPHSs) (3S, 6S, and 10S) (2.5 N, 5 N, 7.5 N, and 10 N). The numerical results showed that the 5-circular perforations heat sink model (5CP) generates the minimum entropy generation and the maximum hydrothermal performance (HTP), around 17% and 1.2, respectively compared to the zero-perforation model, while the circular perforated pinned heat sink (3CP) model produces the maximum reduction in entropy generation, generally around 13% with moderated HTP of 1.1. Moreover, when comparing slotted and notched pinned heat sinks, the 10S slotted and 10 N notched pinned heat sinks achieve 1.45 of HTP.