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# Numerical simulation of heat transfer in porous metals for cooling applications

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## ABSTRACT

Metal foams are a new class of materials with low densities and novel physical, mechanical, thermal, electrical, and acoustic properties. Hence, they have attracted a large amount of interest over the last few decades, leading to improved manufacturing techniques. Although they are made of well-known materials, the different manufacturing processes allow them to have different pore structures and multi-functionality that are of great interest to different industrial sectors. One of their applications is for thermal management in the electronics industry, because of their fluid permeability and thermal conductivity. The heat transfer capability is achieved by the interaction between the internal channels within the porous metal and the coolant flowing throw them.

This paper studies open-cell porous metals made by space holder methods by numerical simulation using software ANSYS-Fluent. A 3D geometric model of the porous structure was created based on the face centred cubic (FCC) arrangement of spheres linked by cylinders. This model allows for different combinations of pore parameters including a wide range of porosity (50–80%), pores size (200–1000), and metal particle sizes (10–75). In this study, water was used as the coolant, and copper was selected as the metal matrix. The flow rate varied in the Darcian and Forchheimer's regimes. The permeability form drag coefficient and heat transfer coefficient were calculated under a range of conditions. The numerical results showed that permeability increases whereas the heat transfer coefficient decreases with porosity and increasing the flow rate leads to a better heat transfer performance. The numerical results agreed well with previous experimental results.

**KEYWORDS:** metal foams, numerical simulation, permeability, drag force coefficient, heat transfer coefficient