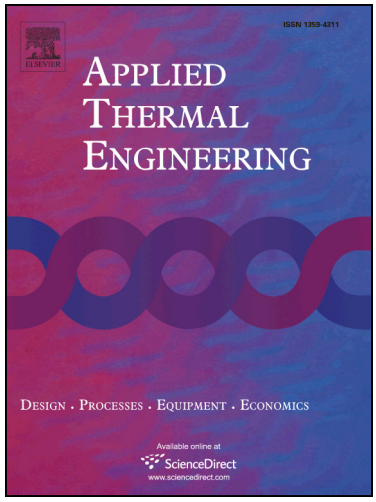

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Radiation Heat Transfer in High Porosity Open-cell Metal Foams for Cryogenic Applications

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Abstract:

Radiation heat transfer in high porosity open-cell metal foams subjected to cryogenic temperatures has been studied. This study helps designing metal-foam-based devices exposed to radiation of deep space at extremely low temperature. Aluminium and copper foam samples with more than 90% and 95% void volume respectively and pore size in the range of 10–30 PPI have been studied. Suspending the foam samples freely inside a vacuum chamber (at 10^{-6} mbar) and maintaining the chamber wall at liquid nitrogen temperature, the cool down time-temperature profiles has been recorded for nearly 5.5 hours, wherein different foams reach temperatures in the range of 119-128K. Simultaneously, theoretical model based on lumped-capacity analysis has been developed to simulate the transient behaviour of foam samples. Simple cubic structure foam model has been used to estimate the view factor. The experimental outcome could be predicted by the theoretical model with reasonable accuracy. Additionally, cool-down history of an aluminium foam sample has been compared to a solid body of same weight so as to appreciate their radiative potential at low temperatures.

Keywords:

Radiation, Experimental transient study, Cryogenics, Aluminium foam, Copper foam