Proceedings of the 5th World Congress on Momentum, Heat and Mass Transfer (MHMT'20)
~~Lisbon, Portugal~~ Virtual Congress – October 2020
Paper No. ICMFHT 124
DOI: 10.11159/icmfht20.124

Flow Boiling of HFE-7100 in Multi-Microchannels: Effect of Surface Material

Ali H. Al-Zaidi[1], Mohamed M. Mahmoud[2], Tassos G. Karayiannis[3]
[1]University of Misan, Al-Amarah, Iraq
alialzaidi@uomisan.edu.iq; mbasuny@zu.edu.eg
[2]Faculty of Engineering, Zagazig University, Zagazig, Egypt, 44519;
mbasuny@zu.edu.eg
[3]Department of Mechanical and Aerospace Engineering, Brunel University London, UK
tassos.karayiannis@brunel.ac.uk

Abstract **–** The effect of surface material on the flow boiling characteristics in a multi-microchannel evaporator is described in this paper. HFE-7100, a dielectric and eco-friendly working fluid, was tested at atmospheric pressure, inlet sub-cooling of 5 K, base heat flux up to 433.5 kW/m^2 and mass flux range 50–250 kg/m^{2}s. Two heat sinks made of copper and aluminium were fabricated having the same channel dimensions giving a hydraulic diameter of 0.46 mm with a base area of 500 mm^2. The average roughness was measured and the values were 0.286 µm and 0.192 µm for the copper and aluminium, respectively. The effect of surface material was not significant at low heat flux. However, it became significant at moderate and high wall heat fluxes. The flow patterns for the two microchannels were similar and included bubble, slug, churn and annular flow. The experimental results showed that the aluminium surface achieved on the average difference of 12% higher heat transfer coefficients than those found in the copper microchannel. It also gave higher flow boiling pressure drop; the average difference was up-to approximately 30%. The different surface microstructures in the two examined heat sinks could explain the different heat transfer and pressure drop behaviour.

Keywords**:** Flow boiling pressure drop, Heat transfer coefficient, Microchannels, Material effect, Electronics cooling.