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Liquid jet impinging orthogonally on a wettability-patterned surface THEODORE KOUKORAVAS, ARITRA GHOSH, PALLAB SINHA MAHAPATRA, University of Illinois at Chicago, RANJAN GANGULY, Jadavpur University, India, CONSTANTINE MEGARIDIS, University of Illinois at Chicago
— Jet impingement has many technological applications because of its numerous merits, especially those related to the ability of liquids to carry away heat very efficiently. The present study introduces a new configuration* employing a wettability-patterning approach to divert an orthogonally-impinging laminar water jet onto a predetermined portion of the target surface. Diverging wettable tracks on a superhydrophobic background provide the means to re-direct the impinging jet along paths determined by the shape of these tracks on the solid surface. In a heat transfer example of this method, an open-surface heat exchanger is constructed and its heat transfer performance is characterized. Since this approach facilitates prolonged liquid contact with the underlying heated surface through thin-film spreading, evaporative cooling is also promoted. We demonstrate flow cases extracting 100 W/cm^2 at water flow rates of O(10 mL/min). By comparing with other jet-impingement cooling approaches, the present method provides roughly four times more efficient cooling by using less amount of coolant. The reduced coolant use, combined with the gravity-independent character of this technique, offer a new paradigm for compact heat transfer devices designed to operate in reduced- or zero-gravity environments. * T. P. Koukoravas, A. Ghosh, P. Sinha Mahapatra, R. Ganguly and C. M. Megaridis, Intl J. Heat Mass Transfer 95, 142-152, 2016.

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