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Experimental investigation of boiling flow heat transfer in small channels

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Flat multi-port extruded aluminium tubes are widely used in car air-conditioning with refrigerant R134a. They consist of numerous parallel mini-channels, with hydraulic diameters about 1 mm. The use of these channels allows to reduce the fluid inventory, and increase the heat transfer efficiency, thus saving space, energy and refrigerant fluid. This complies with the new environmental policies on global warming requiring that emissions of gases with significant greenhouse effect should be decreased. For the time being these mini-channels are used in car air-conditioning condensers, but their use for evaporators still requires further studies. Thus the experimental study of boiling flow heat transfer in such channels is presented. The tested fluid is R134a and the test sections are made of 2.01 and 0.77 mm hydraulic diameter parallel rectangular channels. The mass flux ranges from 90 to 626 kg/m²s and heat flux from 6 to 19.5 kW/m², at working pressures of 4 and 5 bar. A comparison of the boiling regimes identified in both cases is exposed and the influence of confinement on heat transfer is investigated. Thanks to local temperature measurements the enhancement of heat transfer and the prevailing of partial dry-out due to the confinement are highlighted.