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Influence of surface modifications and channel structure for microflows of supercritical carbon dioxide and water

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Abstract

Miniaturization offers a possibility to increase the performance and decrease the time scales of systems. Existing microsystems using supercritical CO_2 mainly utilizes multiphase segmented flows. To allow for a broader toolbox for future systems, also parallel flows are useful which eases the separation of the different phases. Here, the effect of different surface coatings are studied for multiphase flows of $scCO_2$ and H_2O in flat microchannels, with and without a 4 µm high ridge guide, which allows for pinning of the fluid interface inside the 190 µm wide and 35 µm high channel. Three different surfaces with different wettings towards $scCO_2$ and H_2O are studied, where a surface terminated with a hydrocarbon-based silane was observed to be neutral in the $H_2O/scCO_2$ system, a surface terminated with a fluorocarbon-based silane was hydrophobic, and an uncoated glass surface was hydrophilic.

Using two flow rates of 5:5 µl/min (CO_2:H_2O) and 6.5:3.5 µl/min (CO_2:H_2O), a parallel flow between $scCO_2$ and H_2O was observed for uncoated and flat channels where the H_2O flow pushed the CO_2 to the side, before the flows eventually breaks up into segments. With a ridge guide in the middle of the channel, the interface was pinned at half the channel width, although still breaking up into segments. The neutral hydrocarbon-based surface coating with approximately 90° contact

* Equal contribution of both authors