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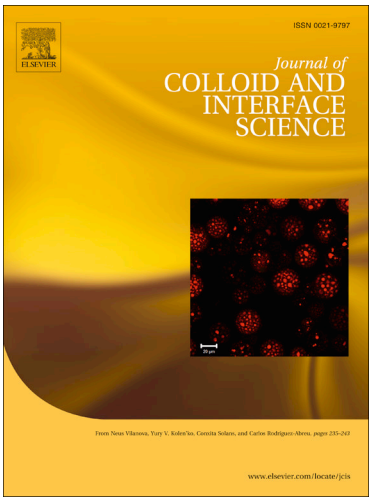

Spontaneous Rise in Open Rectangular Channels under Gravity

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Abstract

Fluid movement in microfluidic devices, porous media, and textured surfaces involves coupled flows over the faces and corners of the media. Spontaneous wetting of simple grooved surfaces provides a model system to probe these flows. This numerical study investigates the spontaneous rise of a liquid in an array of open rectangular channels under gravity, using the Volume-of-Fluid method with adaptive mesh refinement. The rise is characterized by the meniscus height at the channel center, outer face and the interior and exterior corners. At lower contact angles and higher channel aspect ratios, the statics and dynamics of the rise in the channel center show little deviation with the classical model for capillarity, which ignores the existence of corners. For contact angles smaller than 45°, rivulets are formed in the interior corners and a cusp at the exterior corner. The rivulets at long times obey the one-third power law in time, with a weak dependence on the geometry. The cusp behaviour at the exterior corner transforms into a smooth meniscus when the capillary force is higher in the channel, even for contact angles smaller than 45°. The width of the outer face does not influence the capillary rise inside the channel, and the channel size

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