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Numerical Simulation of Structured Roughness Effect on Fluid Flow Characteristics and Heat Transfer in Minichannels

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Abstract : It has been well established that there are no differences between microscale and macroscale flows of incompressible liquids. However, surface roughness has been known to impact the transport phenomena. The effect of structured roughness on the dynamics and heat transfer of water flowing through minichannel was numerically investigated in this study. Our study consists in characterizing the dynamic field and heat transfer aspect of a flow in circular minichannel equipped with structured roughness using CFD software, CFX. The study is performed to understand the effect of various roughness elements (rectangular, triangular), roughness height and roughness pitch on the friction factor and heat transfer coefficient. Our work focuses on a water flow inside a circular mini-channel of 1 mm in diameter and 10 cm in length. The speed entry into the mini-channel varies from 0.1 m/s to 25 m/s. The wall of the mini-channel is submitted to a constant heat flux; q=100,000 W/m². The simulations results are compared to those obtained with smooth minichannel and the existing experimental and numerical results in the literature.

Keywords : heat transfer, laminar and turbulent flow, minichannel, structured roughness
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