LAMINAR FLUID FLOW AND HEAT TRANSFER
CHARACTERISTICS OF WAVY MICROCHANNELS WITH WALL PHASE SHIFT

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ABSTRACT

- 3D Conjugate Analysis was done to investigate the influence of wall phase-shift on the flow behavior and heat transfer characteristics of the wavy micro-channels in the low Re laminar flow regime.
- 7 different configurations with φ = 0°, 30°, 45°, 60°, 90°, 135°, 180° were studied for Re = 50, 100, 150, 200 flow conditions.
- Single microchannel engraved on a copper block with water as working fluid was used.
- In the low Re regime, channel with φ = 60° was found to have best heat transfer characteristics.
- With increase in Re, φ = 0° channel was found to perform better, which can be explained by the increase in strength of Dean vortices due to higher Re and higher asymmetry.

RESULTS

- Continuity, Navier Stokes and Energy Equations were solved using a 3D conjugate analysis for a laminar, incompressible flow in steady state.
- Single micro-channel engraved on a copper block with water as the working fluid. L = 15000 μm, λ = 1000 μm, A = 150 μm, W x H = 400 x 400 μm², Wa = 250 μm.

CONCLUSION

- In the low Re regime, φ = 60° channel was found to have highest average Nusselt Number. As the Re was increased, φ = 0° showed better heat transfer characteristics.
- Flow characteristics vary significantly with phase-shift. More asymmetric channel causes a more asymmetric flow.
- Presence of Dean and expansion vortices have been observed in all the channels, which cause higher mixing of flows.