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Effect of Aspect Ratio on the Performance of Spiral-Channel Viscous Micropump M.I. KILANI, A. AL-SALAYMEH, A.T. AL-HALHOULI, University of Jordan, Amman, Jordan, M. GAD-EL-HAK, Virginia Commonwealth University — The effect of aspect ratio on the flow field in a newly developed spiral-channel viscous micropump has been investigated. An approximate 3-D analytical solution to the flow field in the lubrication limit that ignores channel curvature but accounts for finite wall-height is first developed. A number of models for spiral pump with different aspect ratios are then built and analyzed using the finite-volume method. The numerical and analytical results are in good agreement and tend to support one another. The results are also compared with an approximate 2-D analytical solution developed for infinite aspect ratio, which neglects the effect of sidewalls and assumes uniform velocity distribution across the channel width. This approximation was found valid for aspect ratios of 10 or greater. For aspect ratios less than 10, the flow rate deviates from the 2-D approximation. Shape factors were developed in the present work to express the effect of the pressure difference and boundary velocity on the flow rate at various aspect ratios for both moving and stationary walls. It has been found that the flow rate varies linearly with both the pressure difference and boundary velocity, which validates the linear lubrication model employed at the microscale.

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