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A universal scaling for viscous flows around microfabricated pillars NIMISHA SRIVASTAVA, CARL MEINHART, UC Santa Barbara — Complex geometries that involve an intricate network of channels and pillars are increasingly being used in microfluidic devices. Central to the successful operation of these devices is a fundamental theoretical framework that explains the effects and interplay of viscous, inertial and capillary forces in these geometries. One such geometry is a dense (1000 by 1000) array of micron-sized pillars. We will present a universal scaling (over four orders of magnitude) that predicts viscous, pressure driven flows in these pillars. We have developed a finite element model using COMSOL Multiphysics to simulate Stokes flow between pillars. Using curve fitting on flow through a wide range of height, diameter and gap (an order of magnitude), we were able to derive a unique model that will accurately predict flow rates in any given random array of pillars. We have found that the pressure driven viscous flow within pillars depends almost linearly with the height (h) of the pillars while it varies inversely with the square root of the diameter (d) of the pillars. The flow rate follows a 2.33 power of the gap between the pillars. In addition, we have, *for the first time*, observed lubrication- like scaling in low Reynolds number ($\boldsymbol{Re}$<0.5) viscous flows around an array of microfabricated pillars. Our experiments and simulations have explored and validated the design space when $\boldsymbol{h/g}$ and $\boldsymbol{g/d}$ is between 1 and 10 –s as is the case in most microfluidic applications, which makes this finding imperative for future design of geometries involving pillars, tortuous channels and porous structures.

Nimisha Srivastava
UC Santa Barbara

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