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Experimental Characterization and Modelling of Microfluidic Radial Diffusers

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Abstract : A microfluidic radial diffuser typically comprises a hole in a membrane, a small gap and pillar centred with the hole. The fluid is forced to flow radially in this gap between the membrane and the pillar. Such diffusers are notably used to form flow control valves, wherein several holes are machined into a flexible membrane progressively deflecting against pillars as the pressure increases. The fluidic modelling of such diffuser is made difficult by the presence of a transition region between the hole and the diffuser itself. An experimental investigation has been conducted using SOI wafers to form membranes with only one centred hole and Pyrex wafers for the substrate and pillars, both wafers being anodically bonded after alignment. A simple fluidic model accounting for the specific geometry of the diffuser is proposed and compared to experimental results. A good match is obtained, for Reynolds number in the range 0.5 to 35 using the analytical formula of a radial diffuser in the laminar regime with an effective inner radius that is 40% smaller than the real radius, in order to simulate correctly the flow constriction at the entrance of the diffuser.

Keywords : radial diffuser, flow control valve, numerical modelling, drug delivery
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