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Tailoring concentration gradients in microfluidic networks CYPRIEN GUERMONPREZ, CHARLES BAROUD, SEBASTIEN MICHELIN, LadHyX and Department of Mechanics, Ecole Polytechnique, CNRS 91128 Palaiseau — We aim to produce precise concentration gradients in a microfluidic device in order to generate large number of droplets with a wide range of solute concentration. A method to study the distribution of a diffusing species in a highly parallel microfluidic network is proposed exploiting the spatial distribution of hydrodynamic resistances within the network. Starting from two co-flowing streams, the main channel supplies 10 to 64 side branches connected to a single outlet channel. Experiments and theoretical analysis are carried out for low Reynolds numbers and moderate to high Péclet numbers. The distribution of flow rates within the network is determined from its geometry and the distribution of hydrodynamic resistances and show maximum flow rates through the first and the last branches. Once the velocity distribution is known, a finite-difference method is used to predict the diffusion of a dichlorophenolindophenol solution in pure water. Both experimental and numerical results yield a variety of concentration distribution profiles that range from nearly uniform (small P_e) to linear and sigmoidal profiles (larger P_e). A good understanding of the underlying hydrodynamics enables the design of devices that generate rapidly precise chemical gradients.

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