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A simple microfluidc method for rapid generation of long-range material gradients in microchannels[1] MATTHEW HANCOCK, YANAN DU, JINKANG HE, JOSE URIBE-VILLA, ALI KHADEMHOSSEINI, Harvard Medical School — The ability to recreate the heterogeneity of cellular environments is a major challenge for investigating cell- material interaction and for developing biomimetic materials for tissue engineering. Here we present a simple fluidic method for rapidly generating 2-3 cm gradients of biomolecules, polymers, microbeads, and cells. A polymer hydrogel gradient and a composite material with a cross-gradient of hyaluronic acid (HA) and gelatin in different ratios were generated with continuous variations in material properties. The approach relies on hydrodynamic stretching of the concentration profile and, for molecular species, enhanced lateral molecular diffusion. Faster gradient growth occurs for large Peclet numbers, outside the Taylor-Aris parameter range. Computational simulations and user-friendly power law formulas provide estimates of gradient growth for a wide range of Peclet numbers and channel cross-sections. Our microfluidic platform is limited to a rectangular PDMS microchannel and a syringe pump and should be accessible to a broad range of experimenters in the materials science and biomedical fields.

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