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A microfluidic study of biofilms on topographically complex surfaces WILLIAM DURHAM, ALBERTO LEOMBRUNI[1], MATTHEW MCKINLEY[2], ANNA SHCHERBINA[3], ROMAN STOCKER, MIT — A biofilm forms when bacteria attach to a surface and secrete sticky polymeric substances. Several factors control biofilm formation and maintenance, including cell motility, erosion by fluid shear, bacterial growth, nutrient diffusion, and surface properties. In particular, the surface is often topographically complex and allows heterogeneous microenvironments to develop. We studied how these processes influence biofilm dynamics using a patterned microfluidic channel, composed of an array of cylinders of random diameter and position. We tracked the evolution of a biofilm of fluorescently labeled *Escherichia coli* cells under flow over 48 hours and used periodic injections of microspheres to quantify the flow field. The biofilm first forms as a front that travels three orders of magnitude slower than the mean fluid velocity, then breaks into a series of patches separated by preferential flow channels. This striking channelization was rationalized using a simple network model. A full understanding of these dynamics will be relevant to problems in environmental and medical sciences.

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