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Biofilm streamer formation in a microfluidic porous media mimic

ALOKE KUMAR, Biosciences Division, Oak Ridge National Laboratory, AMIN VALIEI, Department of Chemical and Materials Engineering, University of Alberta, Edmonton, AB, Canada T6G 2V4, PARTHA MUKHERJEE, Department of Mechanical Engineering, Texas A&M University, College Station, TX, USA 77843, YANG LIU, Department of Civil and Environmental Engineering, University of Alberta, Edmonton, AB, Canada T6G 2W2, THOMAS THUNDAT, Department of Chemical and Materials Engineering, University of Alberta, Edmonton, AB, Canada T6G 2V4 — Biofilm formation in porous media is of significant importance in many environmental and industrial processes such as bioremediation, oil recovery, and wastewater treatment. Among different biological and environmental factors, hydrodynamics is considered an important determinant of the dynamics of biofilm formation. In the present study, we fabricated a microfluidic porous media mimic and investigated how fluid flow influences the formation of filamentous structures, known as streamers, between porous media structures. Streamers are viscoelastic materials composed of extracellular polymeric substances (EPS) and bacterial cells, and these filamentous structures are typically tethered at either one of both ends to surfaces. We studied evolution of streamers in different flow rates and identified a tangible link between hydrodynamic conditions and development of these filamentous structures. Our results show that hydrodynamic conditions not only determine the limit of the streamers formation, but also influence both temporal evolution and spatial organization of biofilm streamers.

Aloke Kumar
Biosciences Division, Oak Ridge National Laboratory

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