Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Four-Phase Hybrid Model of Bacterial Biofilm Growth[1] XING JIN, JEFFREY MARSHALL, MATTHEW WARGO, University of Vermont — Bacterial biofilms play a critical role in environmental processes, water treatment, human health, and food processing. They exhibit highly complex dynamics due both to their physical structure and to the complex chemical interactions of the microorganisms that construct them. We present a new type of hybrid computational model that treats biofilms as an interaction between four component types – bacteria, extracellular polymeric substance (EPS), water, and nutrients (substrates). The bacteria are modeled as discrete particles and the other three components are modeled as interacting continua. Bacterial cells consume water and nutrients in order to grow, divide and produce EPS. The model predicts bacterial colony formation as a tree-like structure, with a large part of the EPS production occurring near the colony border where nutrient concentration is highest. EPS flows outward from the bacterial colony, while water flows inward. The lubrication force, the ratio of bacteria and EPS growth rates, the yield coefficient, and osmotic pressure are all found to have important and complex influences on biofilm development.

[1]This work was supported by NASA under cooperative agreement number NNX16AQ96A.

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Date submitted: 31 Jul 2019 Electronic form version 1.4