Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Analysis of a 2D simulation model of biofilms with autonomous cells ANAND BHANDAR, YERGOU TATEK, GARY SLATER, University of Ottawa — Biofilms are substances consisting of a large number of microorganisms that grow on surfaces in contact with liquids. They can be found growing in water pipes, on surgical instruments or on tooth surfaces. Mathematical models have been used for the last three decades in order to improve our understanding of their growth and behavior. We have designed and implemented a new Monte Carlo model based on the life of autonomous cells and investigated the static and dynamic characteristics of the resulting bacterial populations. Each cell is modeled as an autonomous agent whose behavior is controlled by thermodynamic parameters, mechanical properties, physiological rules and environmental conditions. In the 2D version studied, a cell is represented by a closed chain of self-avoiding beads linked together using the bond fluctuation algorithm. The cell is controlled both by the rigidity of its membrane and a pressure difference. The model is complemented by key features such as the processes of cell division, growth and death, attractive interactions between the cell and the surface, and the explicit presence of nutrient diffusion. Tuning model parameters leads to the growth and maturation of various types of biofilms. Typical colonies incorporating these and other important characteristics of biofilms such as the exopolymeric substance (EPS), metabolism and waste production, cell motility and chemotaxy, and cell mutation will be presented.

Gary Slater
University of Ottawa

Date submitted: 11 Jan 2006 Electronic form version 1.4