Abstract for an Invited Paper
for the MAR10 Meeting of
The American Physical Society

Bacterial Biofilms as Complex Communities

HERA VLAMAKIS, Harvard Medical School

Many microbial populations form surface-associated multicellular communities known as biofilms. These multicellular communities are encased in a self-produced extracellular matrix composed of polysaccharides and proteins. Division of labor is a key feature of these communities and different cells serve distinct functions. We have found that in biofilms of the bacterium *Bacillus subtilis*, different cell types including matrix-producing and sporulating cells coexist and localize to distinct regions within the structured community. We were interested in understanding how these different cell types arise. Using fluorescence reporters under the control of promoters that are specific for distinct cell types we were able to follow the dynamics of differentiation throughout biofilm development. We found that a series of extracellular signals leads to differentiation of distinct cell types during biofilm formation. In addition, we found that extracellular matrix functions as a differentiation signal for timely sporulation within a biofilm and mutants unable to produce matrix were delayed in sporulation. Our results indicate that within a biofilm, cell-cell signaling is directional in that one cell type produces a signal that is sensed by another distinct cell type. Furthermore, once differentiated, cells become resistant to the action of other signaling molecules making it possible to maintain distinct cell populations over prolonged periods.