Studies of bacterial cells and cellular assemblies using lab-on-a-chip platform

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Lab-on-a-chip technology offers an array of new possibilities to grow, manipulate, and observe cells and cellular assemblies. In microchips, a controlled environment for cells can be defined and maintained for extended periods of time during which high throughput measurements can be performed. Typical measurements are carried out using optical microscopy but on-chip genetic tools and electrical sensors are also making inroads. Unlike conventional approaches, the microchip technology enables one to perform these measurements in real time and to observe cellular responses to various physical and chemical stimuli as they unfold.

The presentation first overviews recent lab-on-a-chip platforms in studies of bacterial cells, and then describes our efforts in this field. Microfluidic devices have allowed us to determine how bacteria penetrate small pores and channels, elucidate their mechanical properties, and characterize molecular mechanisms that are involved in cell division. While current devices have revealed an array of interesting biological phenomena, the challenge is to develop devices that go beyond proof-of-principle concepts and offer flexible use in a conventional biolab setting.