Use of Microfluidic Device Technology for Biofilm Metabolism and Growth Monitoring

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In nature, including marine environments[1], microorganisms often form surface-associated communities and aggregate that are referred to as biofilm. Because 90% of all microorganisms are estimated to exist in biofilms rather than in the planktonic state, the metabolic activity of these biofilms has a major role in global element cycles. To date, biofilm monitoring studies have been performed using relatively large scaled experimental devices such as flow cells, or continuous reactors. On the other hand, it has been demonstrated that microfluidic device systems can provide a powerful platform for biological assays. A microfluidic device is an "on-chip" liquid handling device that focuses on controlling tiny quantities of liquids to allow chemical assays to be integrated on a small chip. The microfluidic device is advantageous, because it reduces the consumption of reagents and sample solutions, has a short analysis time, is easily automated, and has a low cost. The main purpose of this study is to establish the utility of microfluidic device in biofilm studies. Here we demonstrated that the growth and the metabolic activity of a biofilm can be monitored on a microfluidic device. We first addressed that whether the biofilm growth in the microfluidic device could be visualized and quantified with a modified confocal reflection microscopy techniques (COCRM). Next, we integrated an electorochemical sensor for the monitoring of the metabolic activity of biofilm. The results showed that *Streptococcus mutans* biofilm growth could be monitored with COCRM, and the nitrification activity of activated sludge could be monitored with an ammonium selective electrode. According to these results, we propose that the microfluidic device can be a powerful tool for biofilm studies.

References

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