613a Application of Serpentine Chambers to Improve the Performance of Fiber-Optic Immuno-Biosensor for Cardiac Markers

Yongjie Ren, Junhai Kai, Liang Tang, Bin Hong, SooHyun Lee, Chong Ahn, and Kyung A. Kang

Fluorophore-mediated, fiber-optic immuno-biosensors are being developed to diagnosis heart attack by simultaneously quantifying the levels of four cardiac markers. This sensing system is accurate, rapid (5-10 min), cost-effective, and user-friendly, compared to current diagnostic methods, enzyme linked immunosorbent assay (ELISA). Since the clinically significant sensing ranges of two of four cardiac markers, cardiac troponin I (cTnI) and B-type natriuretic peptide (BNP) are very low (sub-nano molar). Once the first antibodies on the sensor surface use up the analyte, the molecules of the cardiac markers in the bulk flow do not get to the sensor surface very quickly. In such case, according to our study results, convective flow improved the sensing performance significantly.

A microelectromechanical system (MEMS) technique was applied in this biosensing system to make sensor much more efficient in its operation. The inner surface of the sensing can improve the analyte mass transfer by increasing the turbulence in the chamber. A novel, serpentine chamber was created by adding bumps on the inner surface of the chamber. The cross-section of the chamber passage was 1.4x1.4 mm square and the fiber-optic sensors (500 *f*Ým diameter) were inserted at the center of the chamber. The effects of the bump shape, width, and depth and spacing between bumps on the performance of the sensor were investigated. Serpentine chambers have enhanced the performance of the cardiac marker sensor by improving the analyte mass transport to the sensor surface. Round bumps without spacing at the width 2400 *f*Ým and the depth 400 *f*Ým was found to be the optimal bump configuration. Compared to the sensing chamber without bumps, the signal intensity was increased by 65%. The application of bumps in the serpentine chambers also reduced the optimal flow velocity for biosensing by 60%.

We acknowledge the National Science Foundation (BES-0330075) for the financial support.