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MICROFLUIDIC CHANNELS FOR MICROBEAD-BASED ELECTROCHEMICAL IMMUNOASSAY SYSTEM WITH COMB INTERDIGITATED ARRAY

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Introduction

Recently the demand for simple, sensitive and compact detection of biological warfare agent has grown due to the threat of bioterrorism (1) [1]. Miniaturization impacts portability and minimizes the sample volume required for an immunoassay. In electrochemical immunoassay, electrodes are easily miniaturized so that the volume of sample and assay time are decreased. We are investigating the use of magnetic beads for an enzyme labeled immunoassay for utilizing redox cycling to increase the sensitivity. Implementing the assay in a microfluidic format will provide a more convenient method for control of the sample introduction and limit the volume of fluid during the incubation and wash steps.

Design and Preliminary Results

The IDA has two pairs of working electrodes consisting of parallel Pt legs that are interdigitated and insulated with silicon nitride. The redox cycling of electrochemically reversible analytes greatly enhances the current in a stationary solution. The performance of IDAs were compared using paramagnetic beads coated with β-galactosidase, which reacts with 4-aminophenyl β- D-galactopyranoside (PAPG) to produce 4-aminophenol (PAP). This system is very close to the real immunoassays and detailed protocols are described in our previous paper (2,3) [2]. Reference, counter and IDA electrodes were fabricated on a wafer and diced into 10mm*20 mm chips. The reference electrodes were electrically connected for electroplated with Ag. The plating bath contains AgCN and KAgCN and the expected Ag consuming rate is 4 g/A•hr. Average Ag deposition rate is 4 μm/hr with a current of 5 mA.

Microchannel mold was design and built by Stereolithography. A PDMS microchannel defines the sample flow over the electrode array. The magnet holder allows easy alignment relative to the silicon chip and later removal of the magnet during the assay. No leakage was observed for flow rates of 0.01~10 mL/min. To efficiently collect and removed the beads, optimization of flow rate of the solution is required. The beads were observed to collect at the electrode at a flow rate of 0.1 mL/min. However, a microscopic inspection is needed to get more quantitative and systematic data. A simpler microchannel will be built with flat and thin top layer for the measurement of bead collecting efficiency versus flow rate.

Acknowledgement

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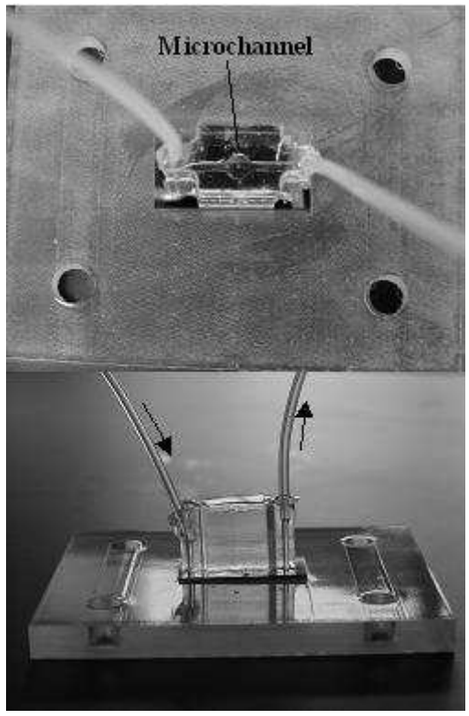

Figure 1. Test setup