Multiplexed Nanomembrane-Based Protein Biomarker Detection

Vic Chica
Portland Community College

In conjunction with:
Biomedical Microdevices and Nanotechnology Lab
Portland State University
Portland, OR

Summer 2006

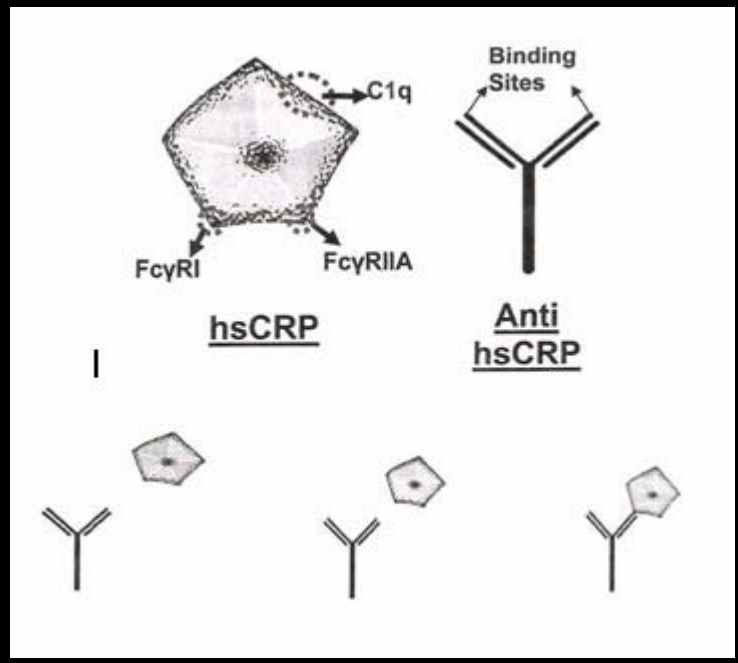
Outline

- Introduction
- Project Objectives
- Intermediate Goals
- Materials and Methods
- Results
- Conclusions / Discussion

Introduction

- Bio-MEMS Technology
- C-reactive protein (CRP) and Myeloperoxidase (MPO)
  - Warning signs of inflammation, obesity, and rupture of arterial plaque.
- Detection of CRP and other proteins:
  - Current Standard: ELISA (Enzyme Linked Immunosorbent Assay) technology
  - Possible Bio-MEMS-based alternative
- Nanomembrane-based alternative has significant advantages
  - Shorter turnaround time
  - Greater sensitivity
  - Multiplexing

Introduction



Binding Process of CRP and anti-CRP Antibody

Project Objective

- To fabricate protein biomarker detectors that use multiplexed nanoporous alumina membranes.

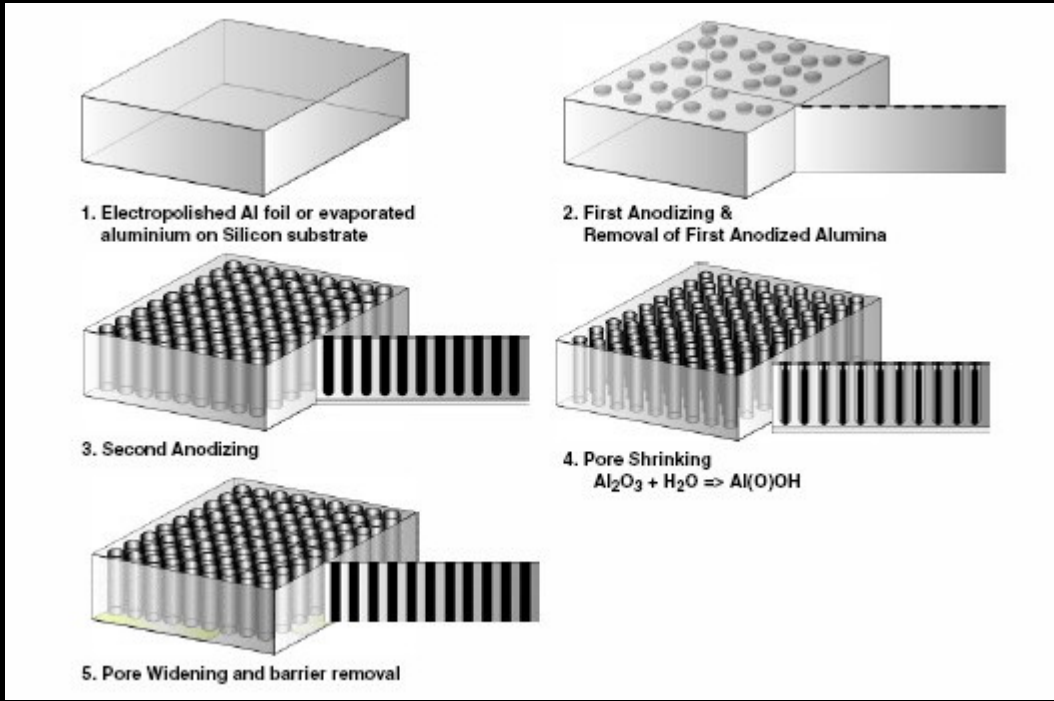
Desired End State:

- Detection, via electronic signature, of at least two protein biomarkers (CRP and MPO) using multiplexed nanomembranes created on a silicon base.

Intermediate Goals

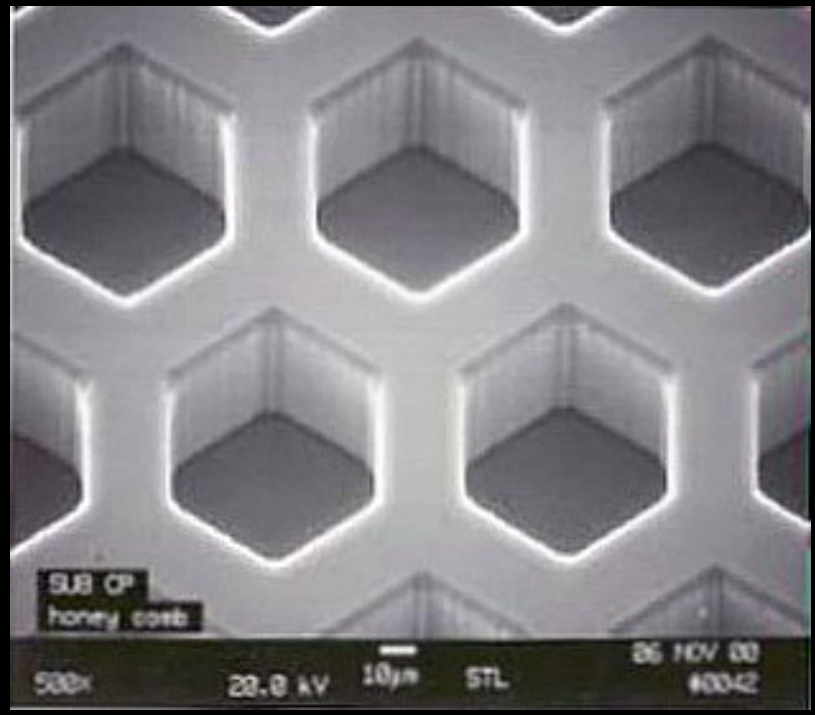
- **Production of Nanoporous Membranes: Determine the parameters and conditions necessary to produce the pore sizes needed, then produce membranes with gold electrodes.**
- **Fabrication of PDMS Stamps: Stamps used for channeling of serum; involve making photoresist structures using photolithography.**
- **Binding: Fuse together structures from previous steps.**
- **Optimization: Test and correct for false-positives, false-negatives. Find a way to seal the apparatus.**

Materials and Methods



Anodization Process

Materials and Methods

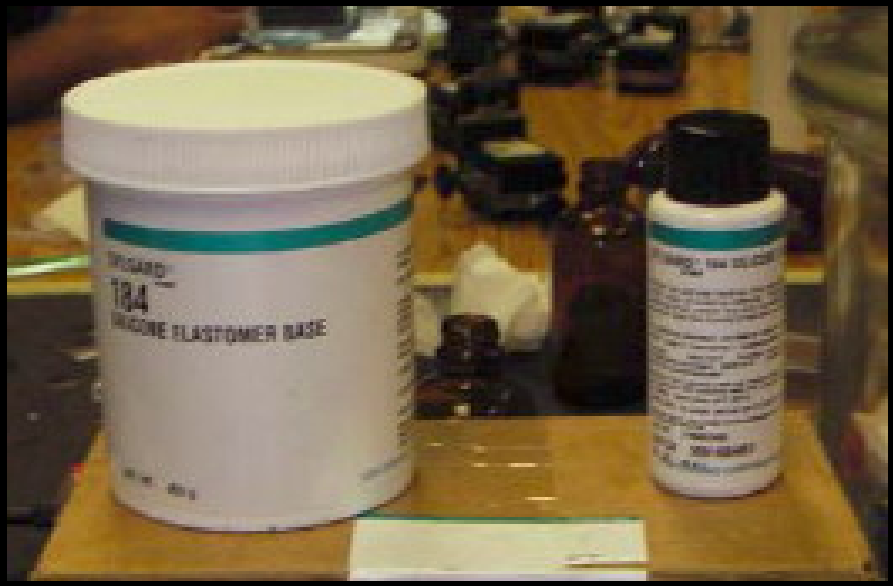


SU-8 50 Photoresist

Materials and Methods

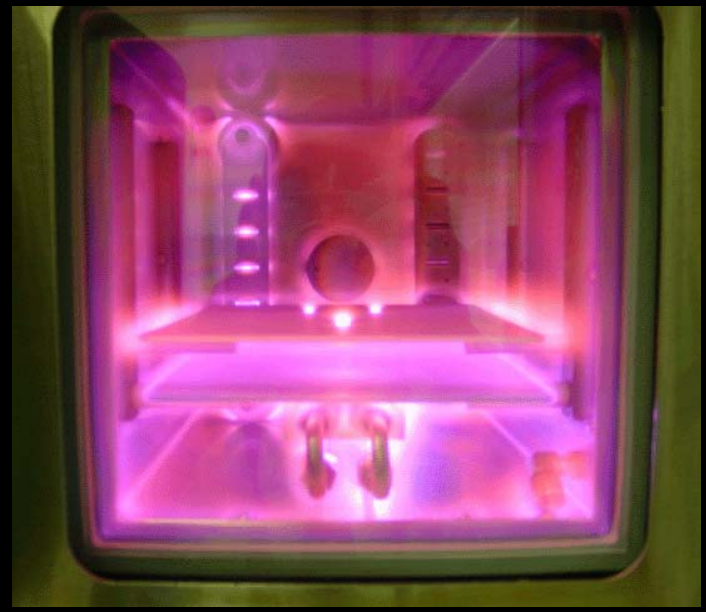
OAI Tabletop Mask Aligner

Materials and Methods



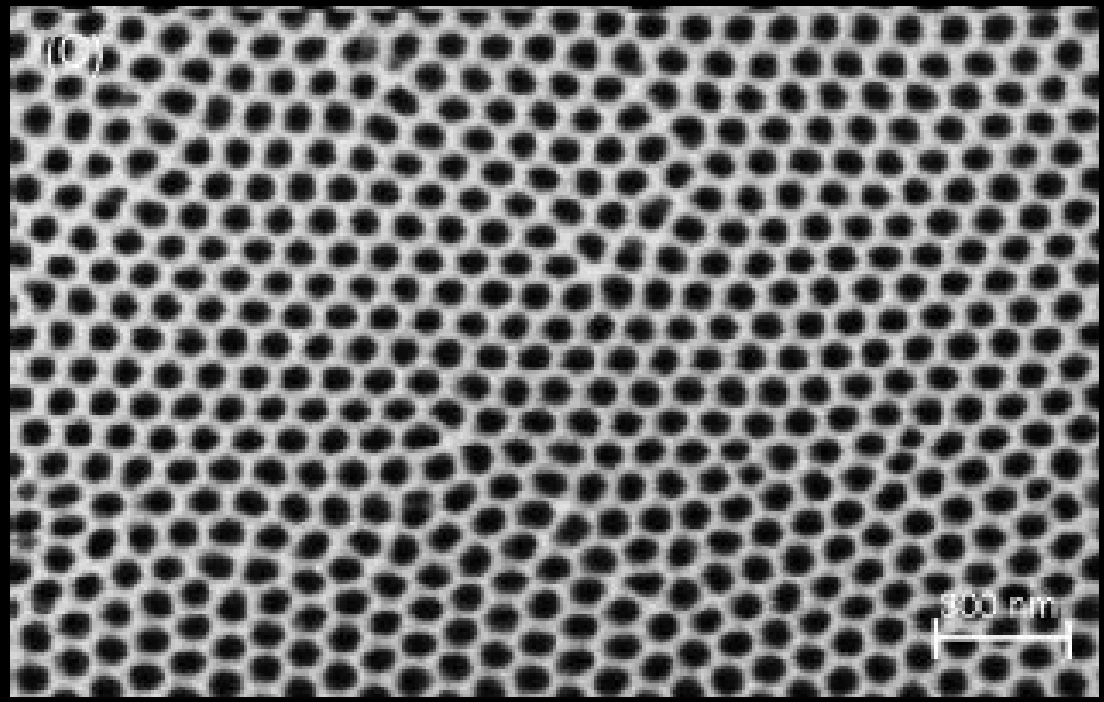
PDMS Kit and Stamps

Materials and Methods



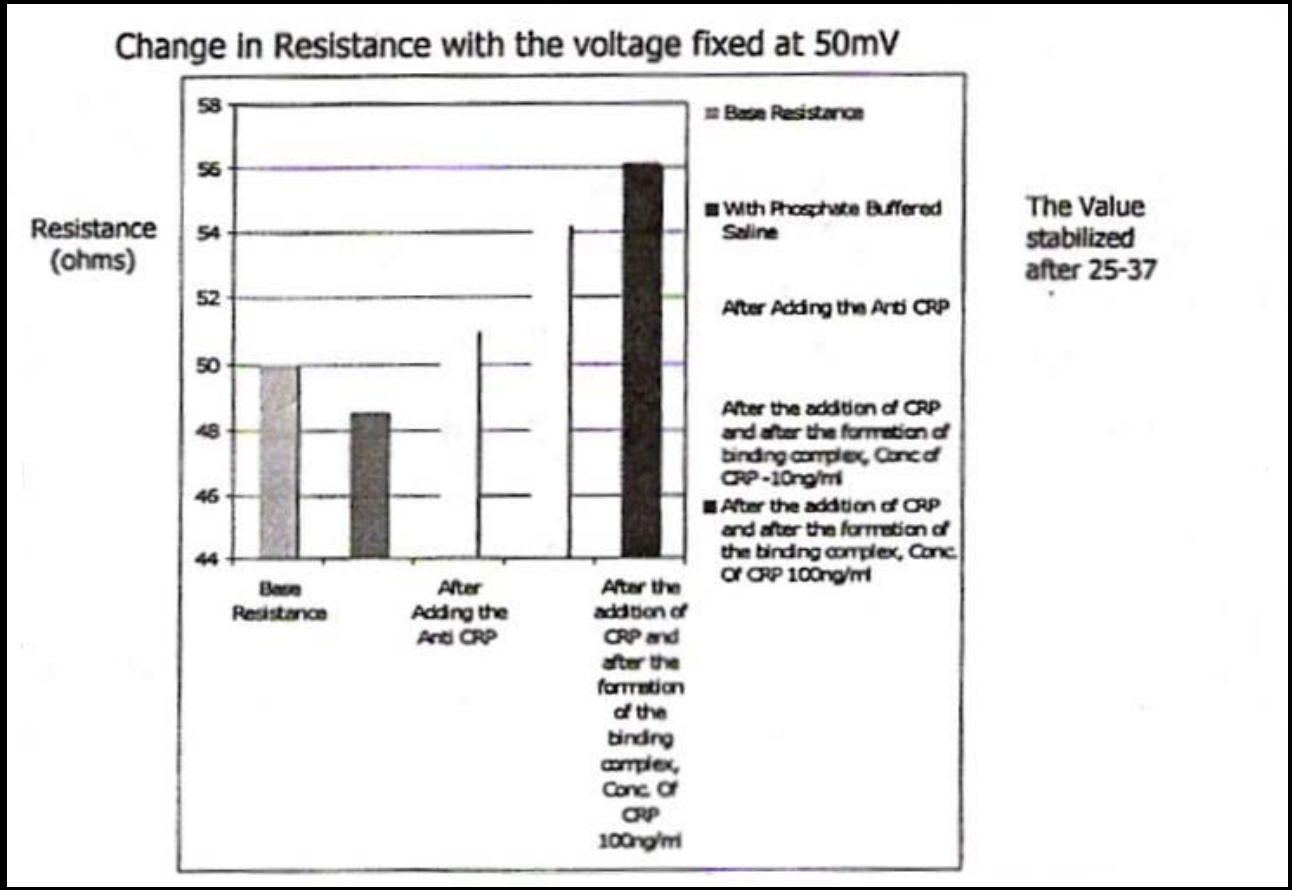
Oxygen Plasma Cleaner

Results



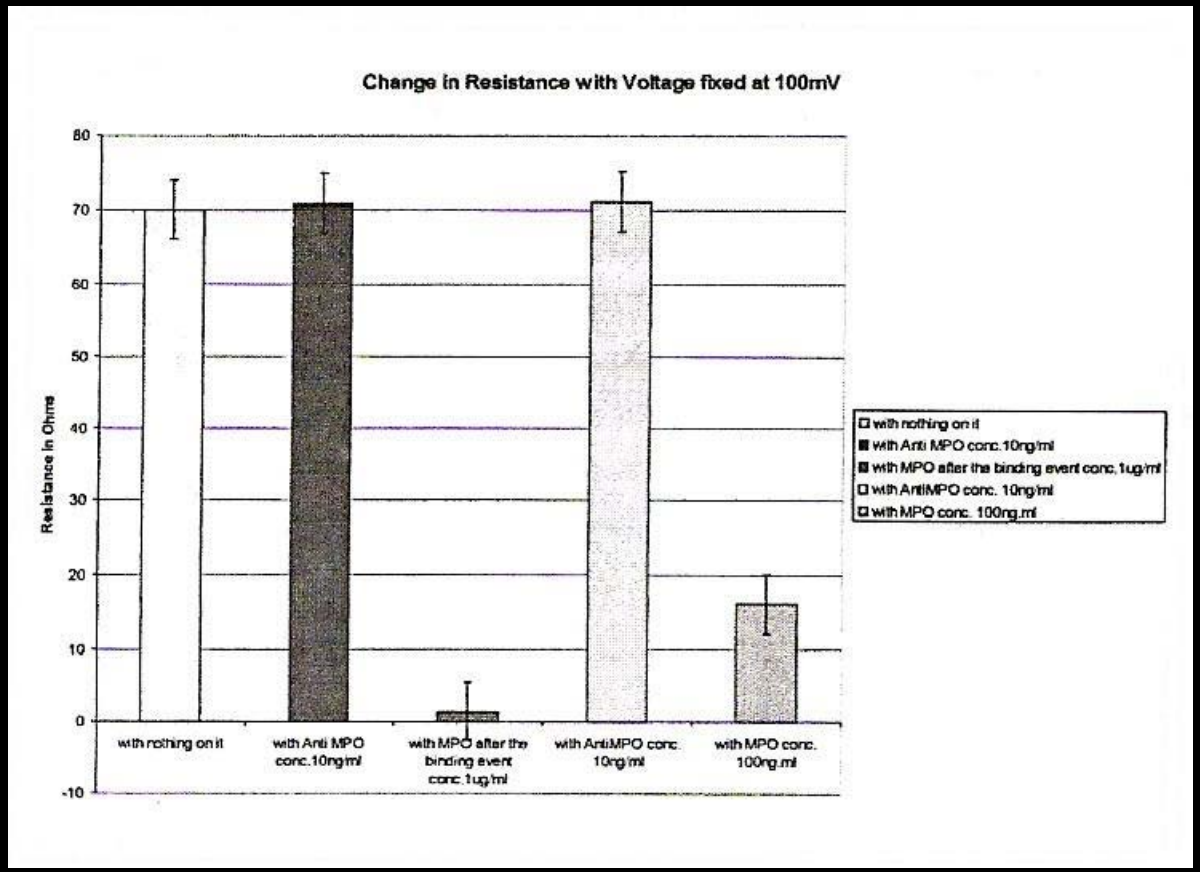
Completed nanoporous membrane (ideally, anyway)

Results



Results from a previous similar project

Results


Change in Resistance with Voltage fixed at 100mV
Resistance in Ohms
80
70
60
50
40
30
20
10
0
-10
with nothing on it
with Anti MPO conc.10ng/ml
with MPO after the binding event conc.1ug/ml
with AntiMPO conc. 10ng/ml
with MPO conc. 100ng.ml
with nothing on it
with Anti MPO conc.10ng/ml
with MPO after the binding event conc.1ug/ml
with AntiMPO conc. 10ng/ml
with MPO conc. 100ng.ml

Conclusion / Discussion

- Nanomembrane-based protein biomarker detection is a feasible concept and a likely replacement for ELISA-based detection.

Acknowledgements

- Dr. Shalini Prasad
- Ravi K. Reddy
- Dr. Jun Jiao
- Fellow REU students and professors

This work was supported by a Research Experience for Undergraduates grant from the National Science Foundation.