Title
On-Chip Chromatography-Based Chemical Sensing

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On-Chip Liquid Chromatography-Based Chemical Sensing

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Abstract

We have developed an integrated ion-exchange liquid chromatography chip, which is integrated with column, frits/filters, injector and conductivity detector. On-chip separation and detection of anions in water (~25ppm) have been successfully demonstrated. To our knowledge, this is the first demonstration of beads-packed column liquid chromatography on-a-chip. Besides conductivity sensing, we are also developing a Surface Plasmon Resonance (SPR) based chemical sensor, for its exceptional sensitivity and miniaturization capability.

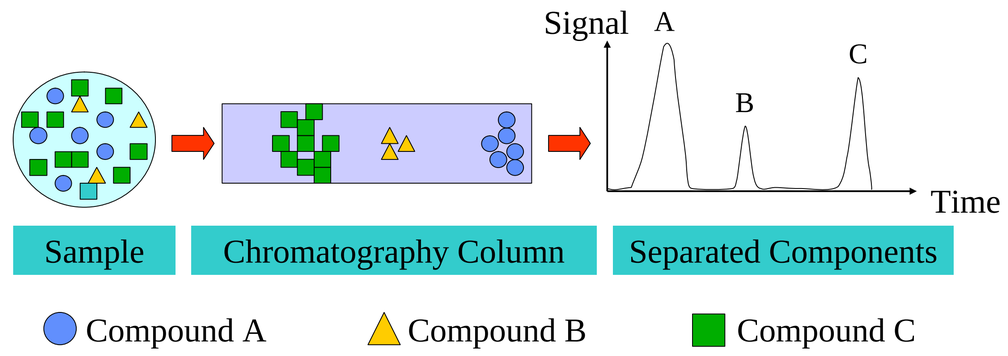

Figure1. Chromatography Principle

Introduction

Liquid Chromatography (LC) is one of the most powerful and versatile separation techniques. However, comparing to electrophoresis, little is published about miniaturizing LC system onto a single chip. The two main reasons are the lacks of: (1) a process to integrate various components of an LC system; and (2) high-pressure microfluidics for pumping liquids through densely-packed beads column. This work attacks both problems.

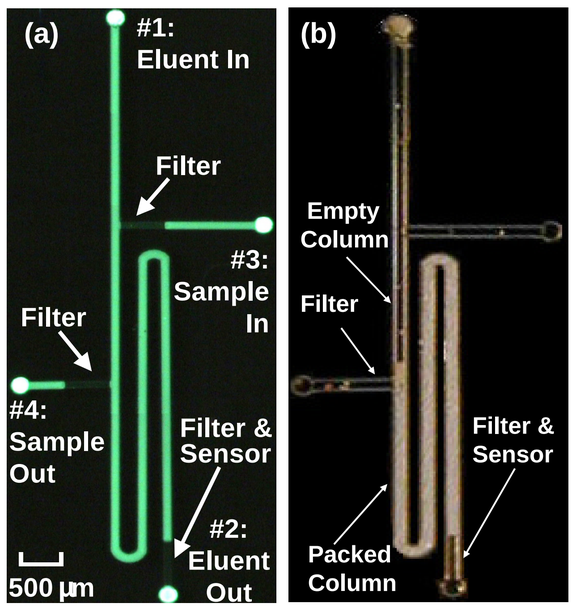

Figure 2. Integrated LC Chip

Surface plasmons are longitudinal electron-density oscillations at interface of a metal and a dielectric medium. Surface plasmon resonance occurs by optical excitation only if the wave of incoming light interacts with the free electrons of the metal and if the energy and momentum of the incident light beam correspond to those of the surface plasmons.

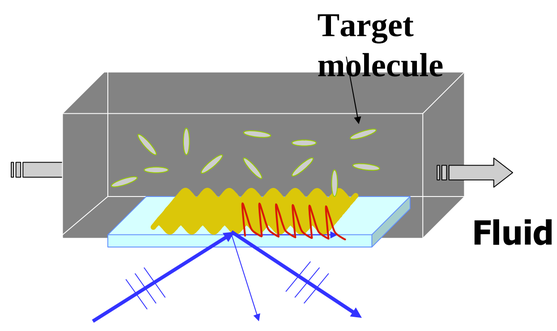

Figure 3. Grating coupler with light coming from the back. The target molecules interact with the grating surface coating and generate signals. SPR has very high surface sensitivity.

Results

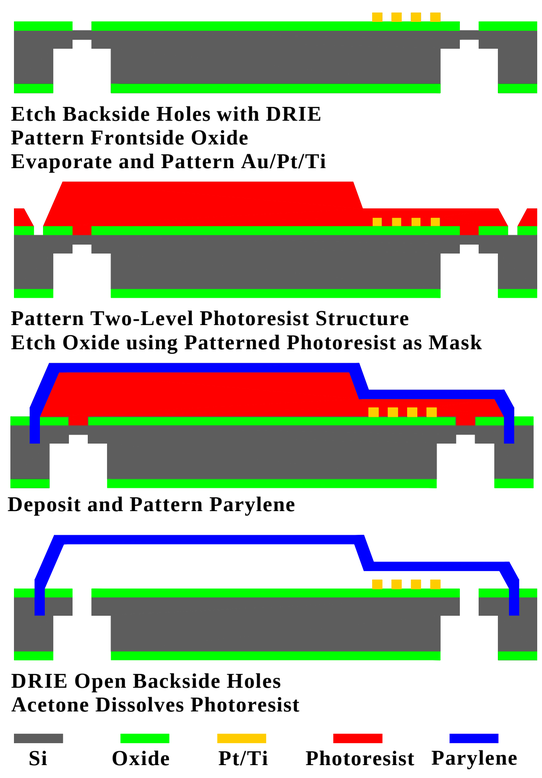

Figure 4. Fabrication Flow

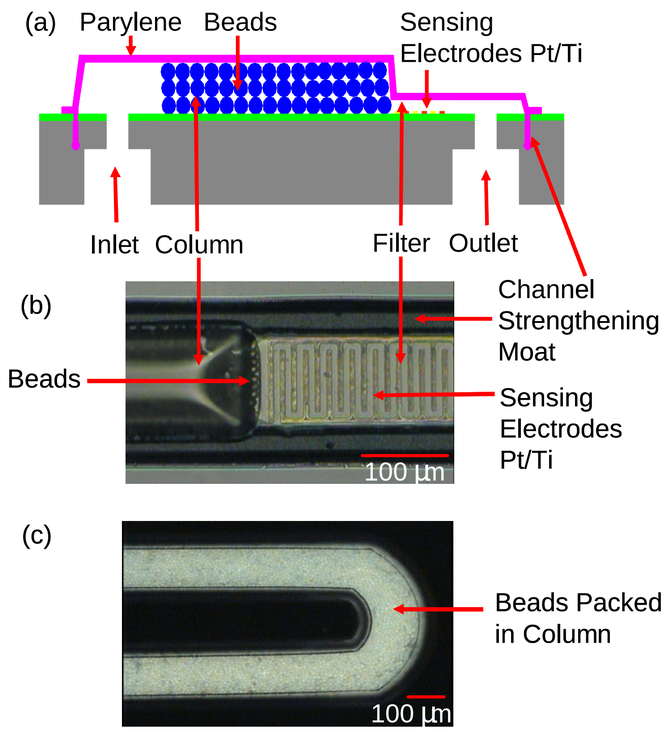

Figure 5. Illustration and pictures of the integrated LC system on-a-chip.

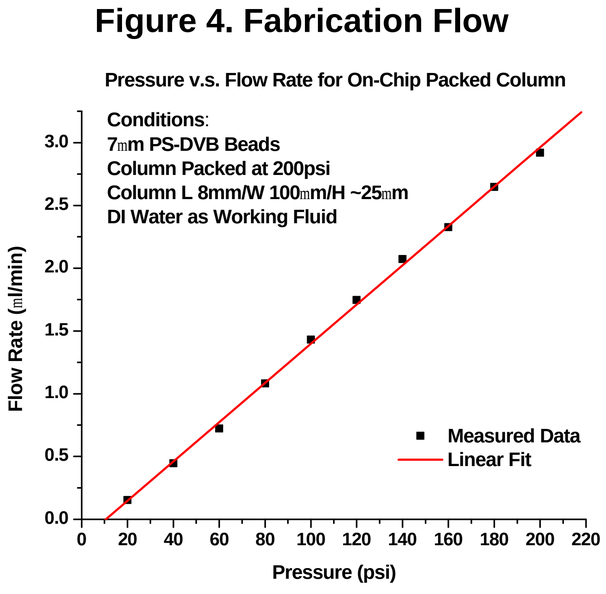

Figure 6. Pressure v.s. Flow Rate for on-chip packed separation column.

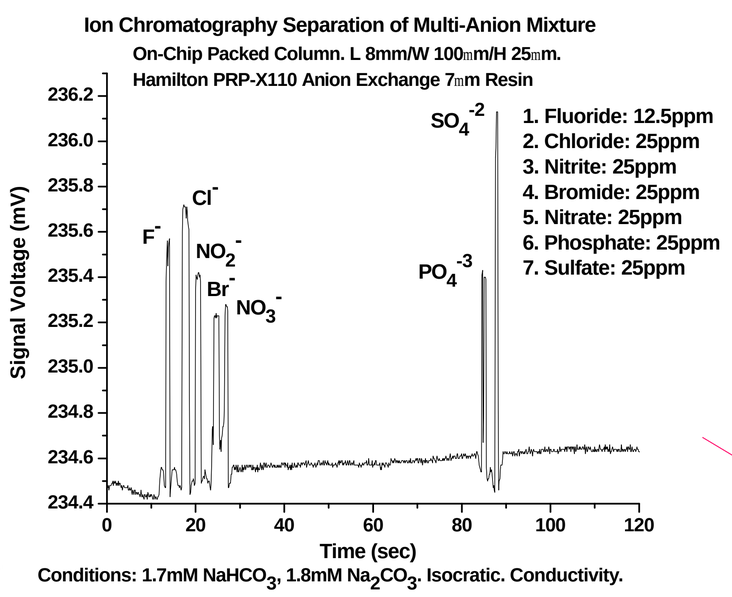

Figure 7. On-chip separation result.

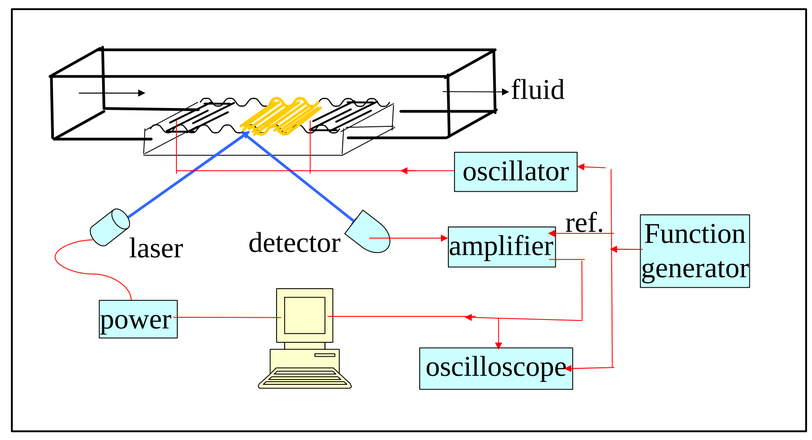

Figure 8. SPR sensor system setup.

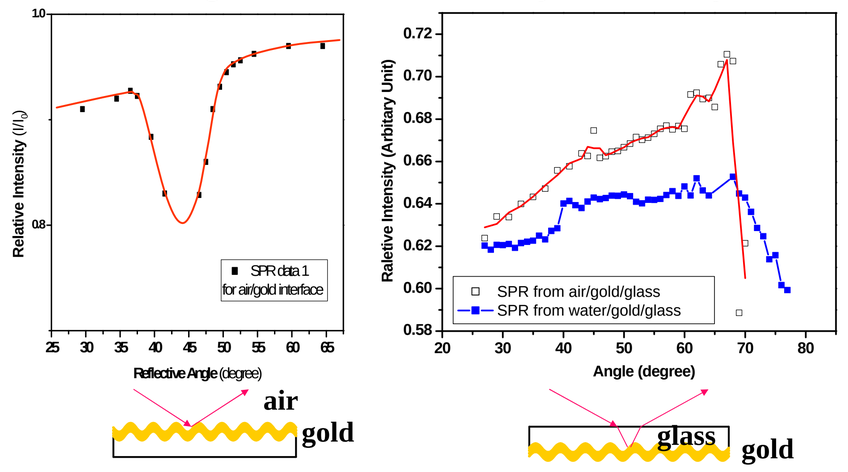

Figure 9. SPR responses for different interfaces.

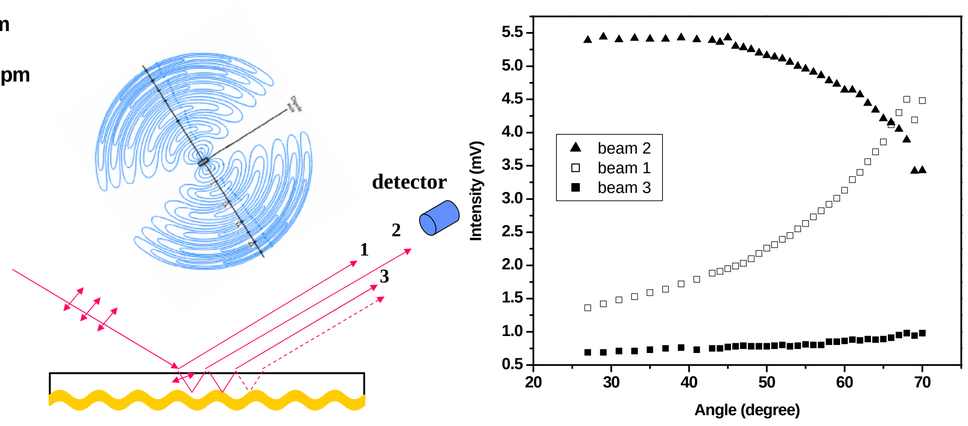

Figure 10. Angular response of the SPR sensor.