

# Micro Capillary Electrophoresis Chips Integrated with Buried SU-8/SOG Optical Waveguides for Biomedical Applications

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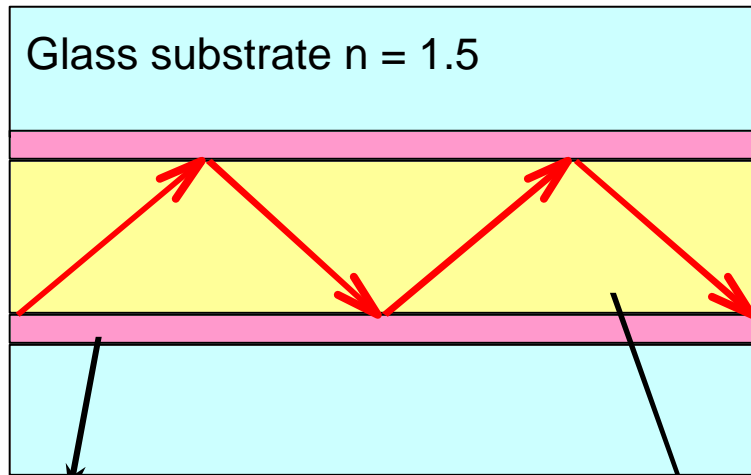
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# Motivation and Objectives

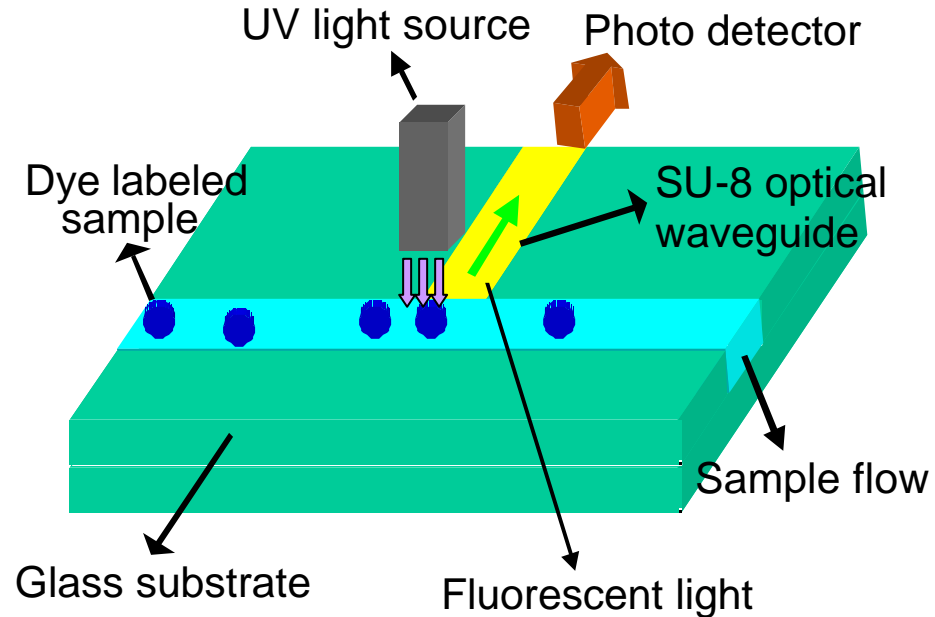
- ❑ Integrate optical waveguide structures with a micro electrophoresis system on a chip.
- ❑ Develop an easy and highly efficient method for light connection form waveguide and optical sensor.
- ❑ Evaluate the performance for the developed devices.
- ❑ Separate and detect bio-molecules using the developed devices.

# Working Principle



SOG coating  $n = 1.36$

SU-8 core  $n = 1.8$

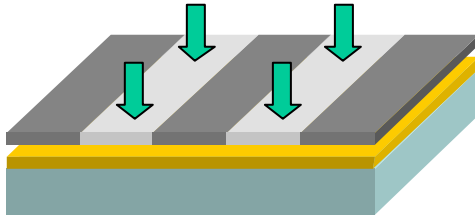


- ❑ SU-8/SOG double layer forms a high efficient optical waveguide structure.
- ❑ No optical alignment and microscopy are required.

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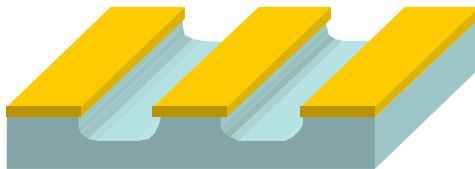
# Fabrication Process



**Lithography**



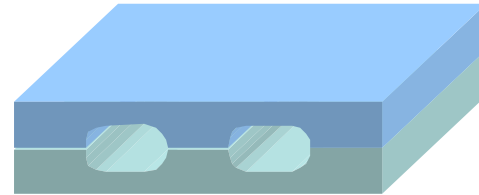
**PR developing**



**Glass etching**



**PR stripping**



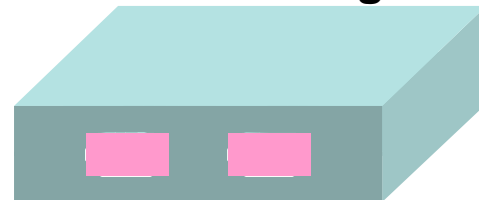
**Alignment and pre-bonding**



**Fusion bonding**

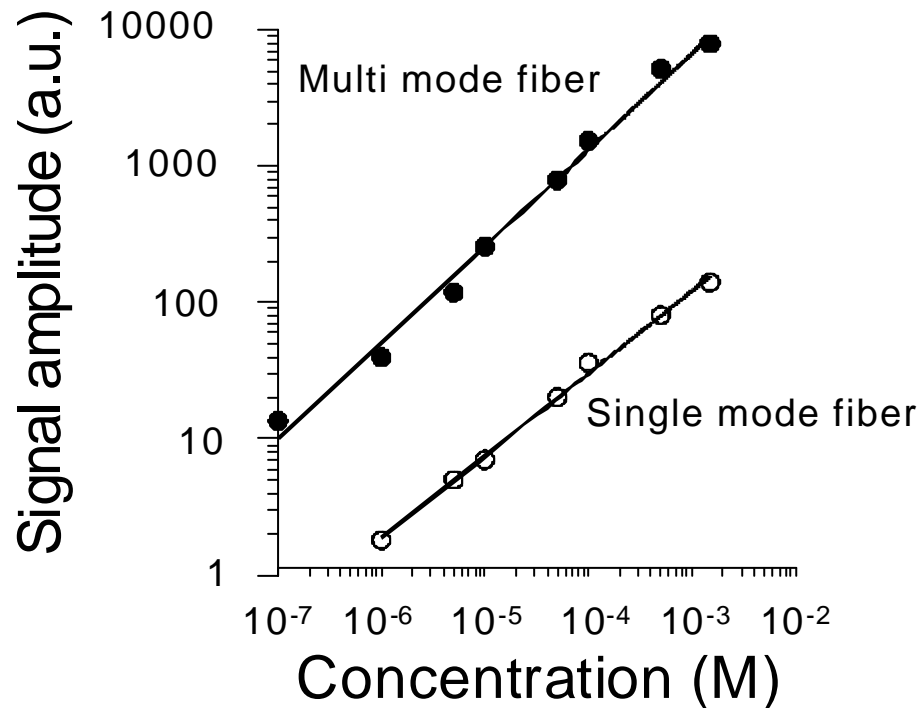
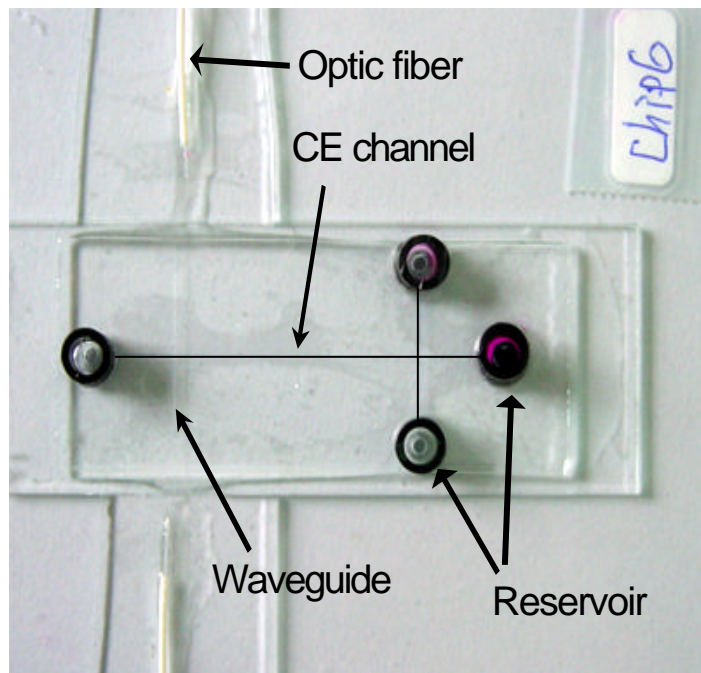


**SOG coating**



**SU-8 PR filling**

# Microfabricated chip and its performance

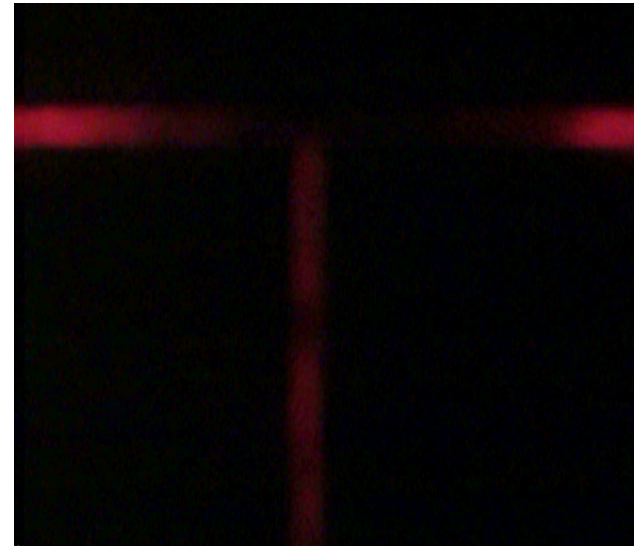
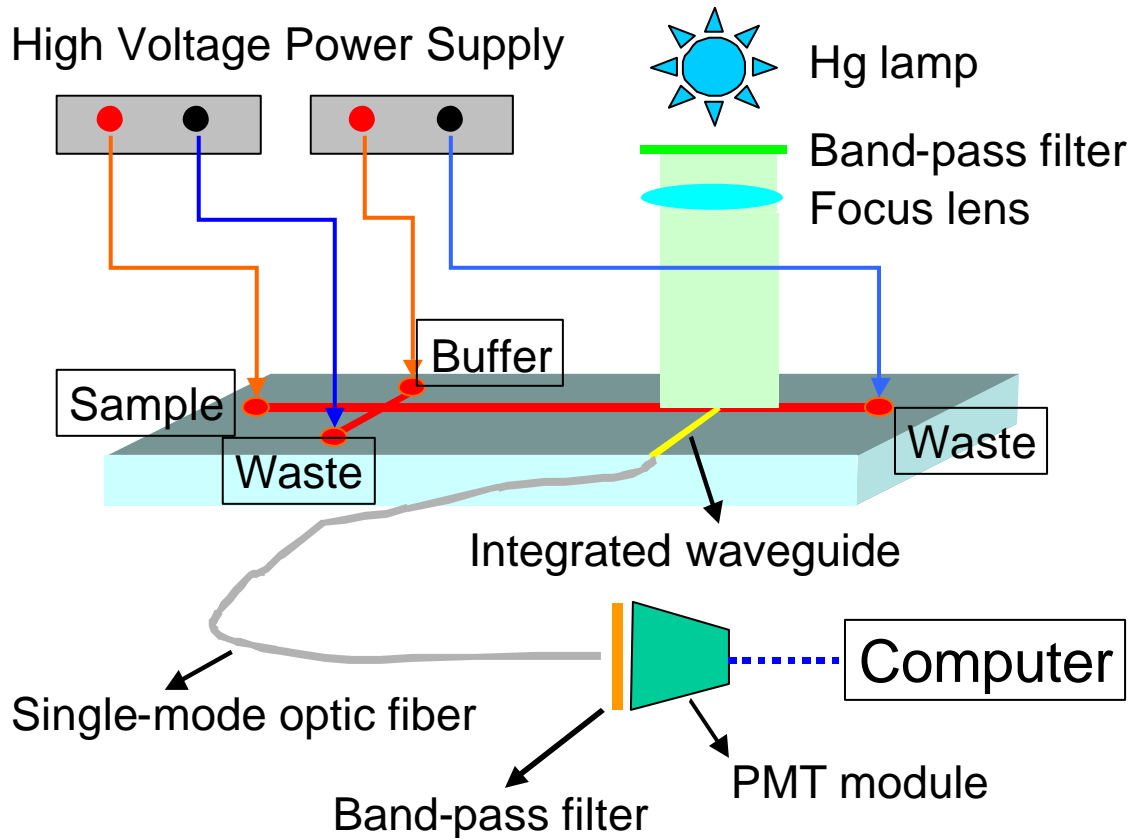


- ❑ Injection channel 10 mm, separation channel 40 mm.
- ❑ Optical waveguide placed at 30 mm away from the cross.
- ❑ Minimal detectable concentration can be as low as  $10^{-7}$  M.

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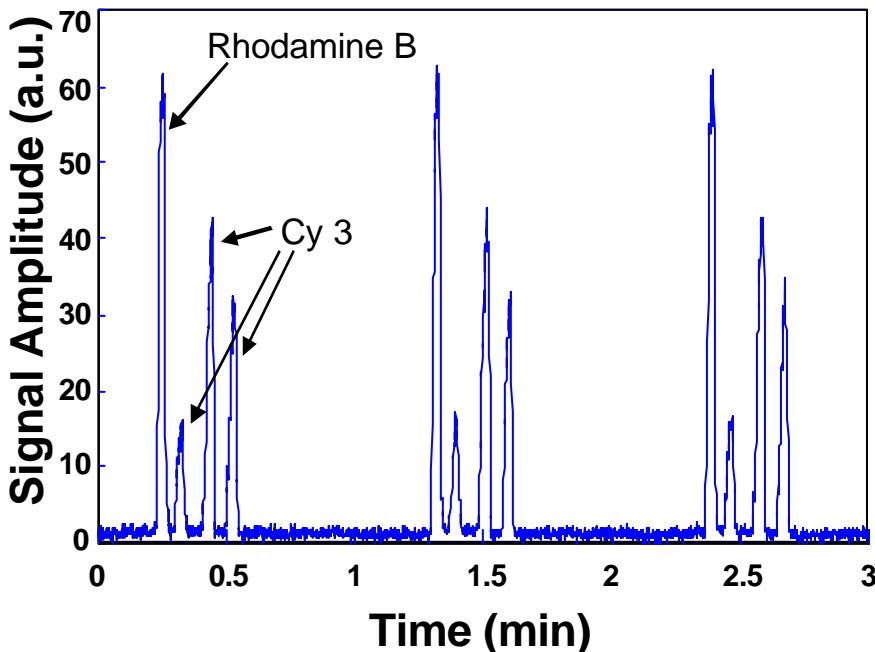
# Experimental setup



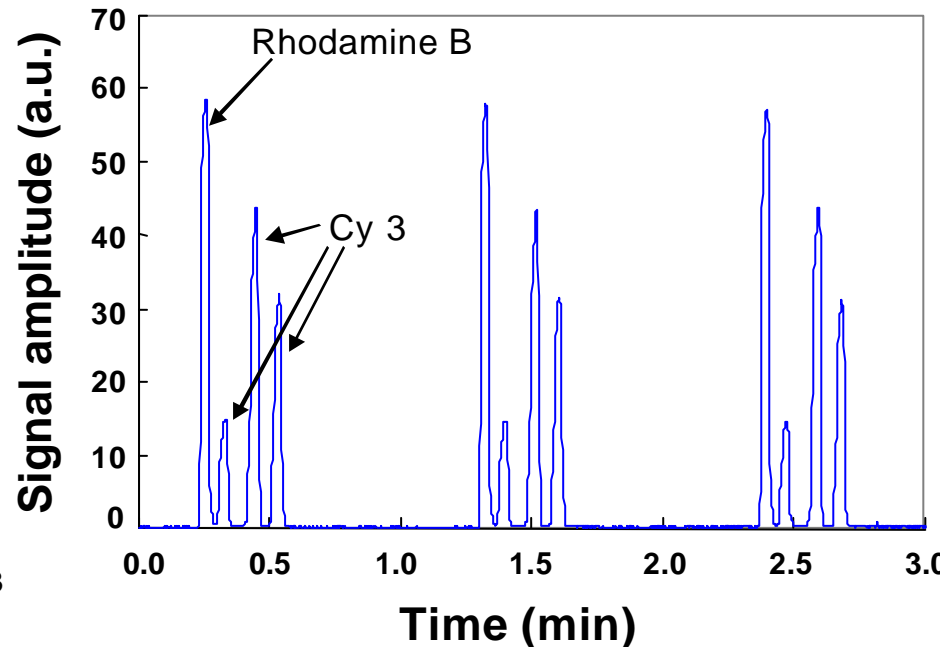
- *Electro-osmotic pumping of sample buffers*
- *Electrophoresis separation of bio-molecules*

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# Separation of a mixture of Rhodamine B and Cy 3



**Proposed method**

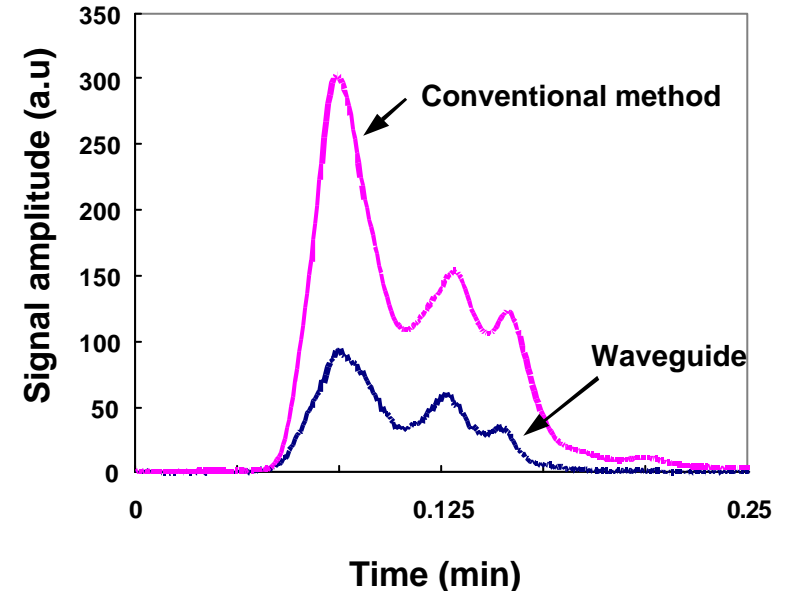
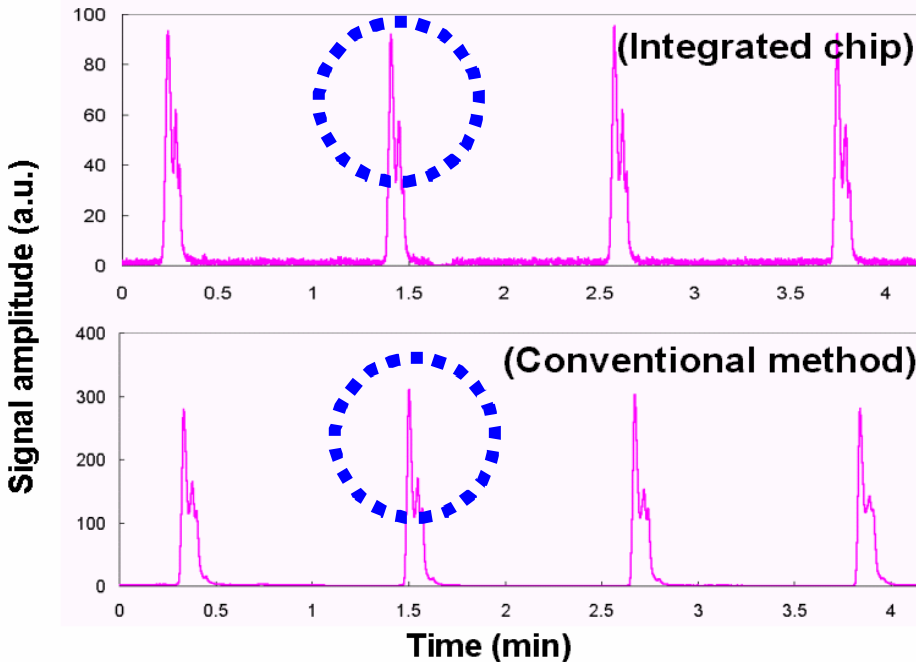


**Conventional method**

- A mixture of  $10^{-4}$  M Rhodamine B and  $6.5 \times 10^{-3}$  M Cy 3 fluorescent dye was successfully separated and detected.

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# Separation of polypeptide chain



- ❑ 250 ppm, FITC-labeled polypeptide (AEEIYGVLF~~AK~~KKK, 70% purity, MW = 2111.39, Sigma, USA)
- ❑ Buffer: 1 mM sodium phosphate mixed with 0.5 mM SDS
- ❑ Separation voltage: 2 kV

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# Summaries

- ❑ Micro capillary electrophoresis chip with integration of buried optical waveguide was demonstrated.
- ❑ Signal amplitude for the multi-mode optic fiber is 39-fold bigger than one for the single-mode fiber
- ❑ The detection can be as low as  $10^{-7}$  M.
- ❑ FITC-labeled polypeptide and a mixture of Cy3 and Rhodamine B fluorescence dye were successfully separated and detected using the developed device.
- ❑ A miniaturized micro CE system could be achieved.

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