

## Bio-Sensors for DNA and pH

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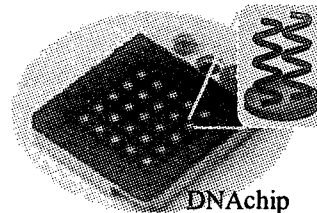
### **Novel Bio-Sensors**

- Smart DNA Sensors by Microfluidic Channel
- pH and Light Fused Sensors for Chemical Analysis

## Background

### **DNA Analysis**

- disease prevention
- early diagnosis
- Gene diagnosis



### **DNA Chips**

- ✓ Many kinds of DNAs is analyze in a same time
- ✓ Reproducibility and reliability : fixed DNA probes on electrode.
- ✓ Reuse

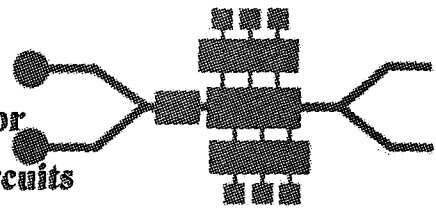


**Novel DNA Sensor**

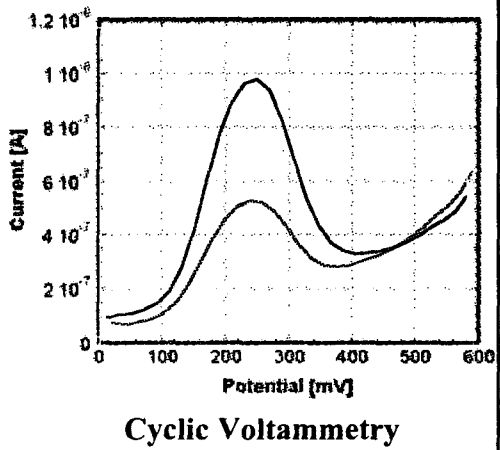
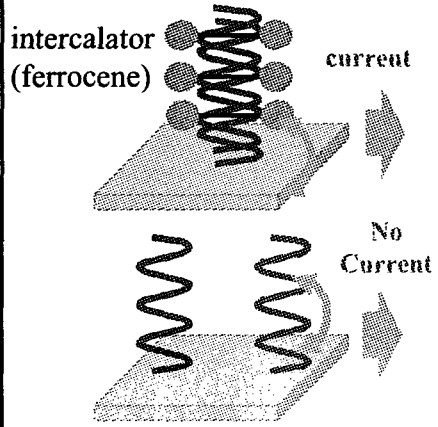
## Object

### Fabrication of Microfluidic Channel Type Smart Electrochemical DNA Sensors

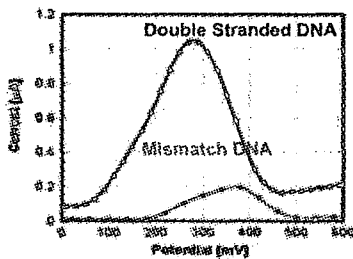
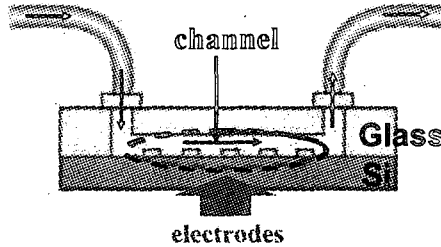
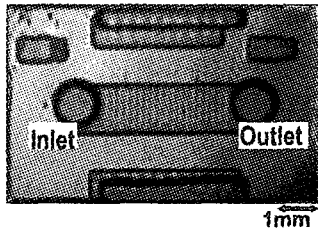
- ✓ Microfluidic DNA sensor
- ✓ Integration of Microreactor
- ✓ Integration of electrical circuits



## Electro-Chemical DNA Sensor



## Microfluidic Channel Type DNA sensor tube



Electro-Chemical Analysis

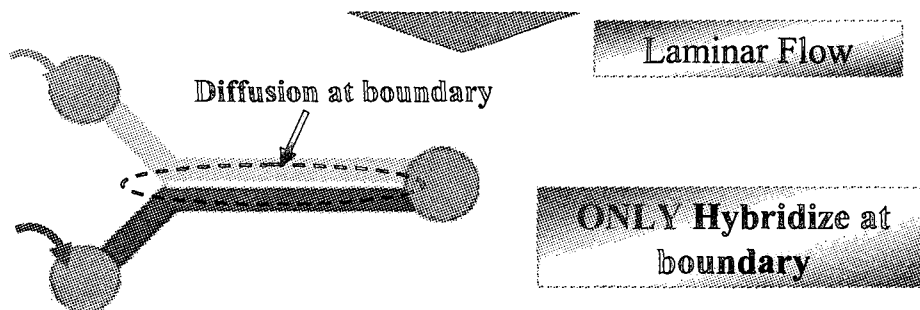
### Successively fabricated Microfluidic DNA sensor w/o fixed probe DNA

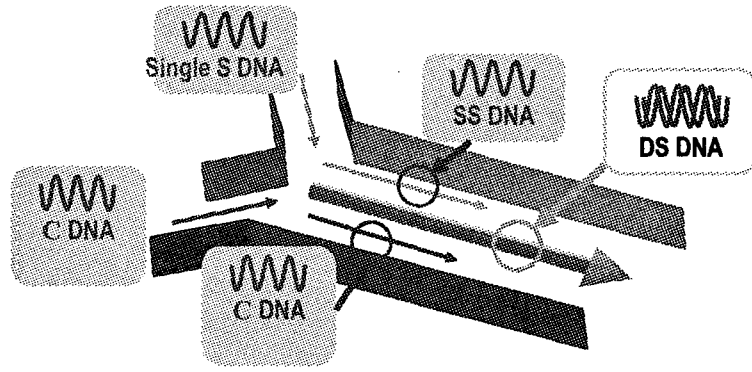
- > compatible to  $\mu$ -TAS
- > reproducibility
- > reuse

## Integrated electrochemical DNA sensors with microfluidics channel reactor

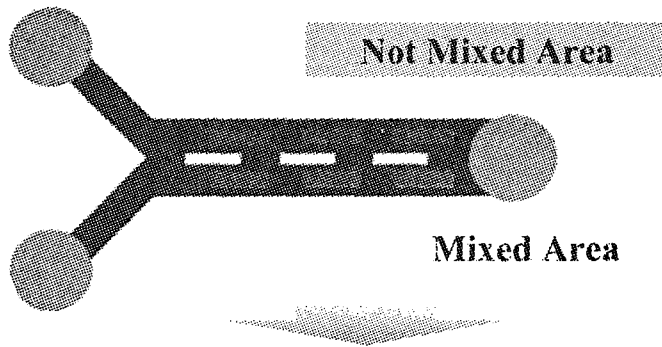
### Point!

- > Hybridization in microfluidic channel

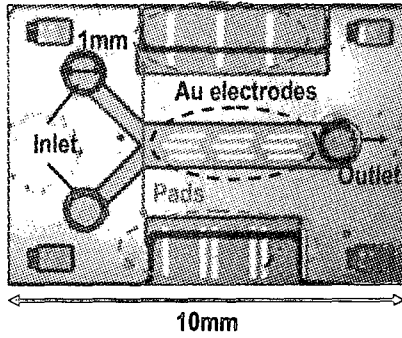




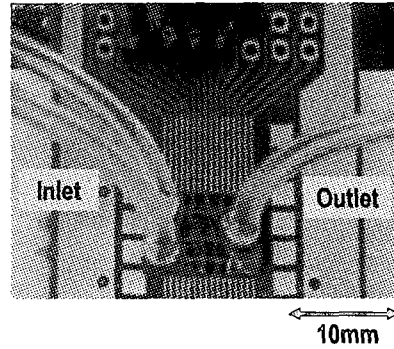
### Integration of Microreactor



➤ Measurements **Mixed Area (signal)** and **Not Mixed Area (ref.)** on a same time.

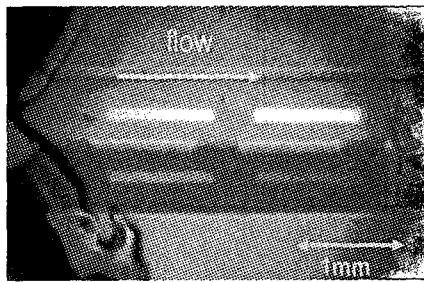


Photograph of Chip



Measurement

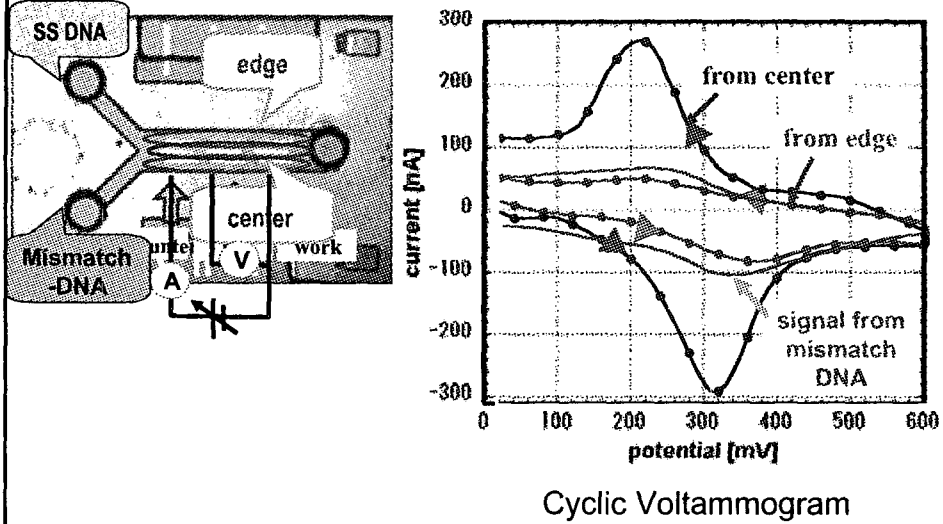
## Confirmation of Laminar Flow



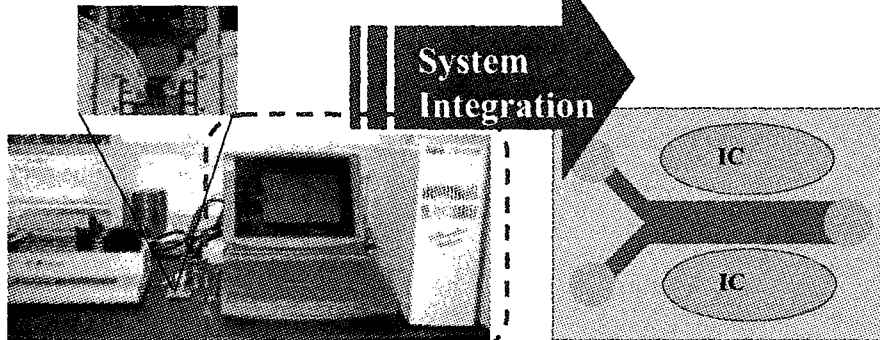
water  
 1% food color  
 Flow velocity 3.7mm/sec

Laminar Flow

## Results



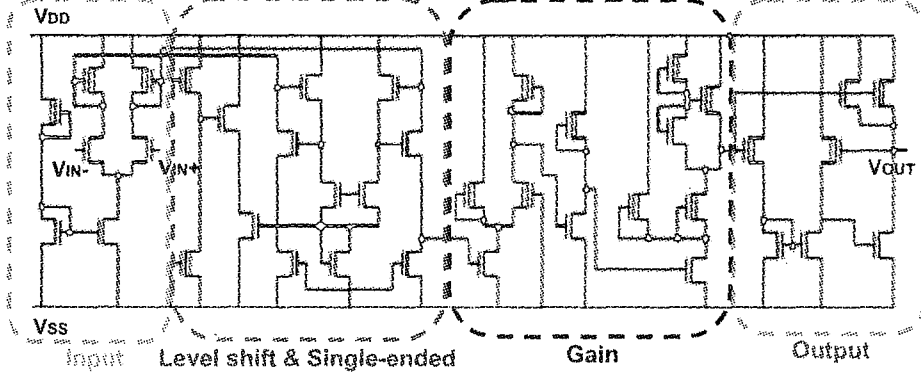
## Smart micro-Chip



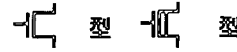
Electro-Chemical  
Measurement Sys.

Not necessary Exclusive System

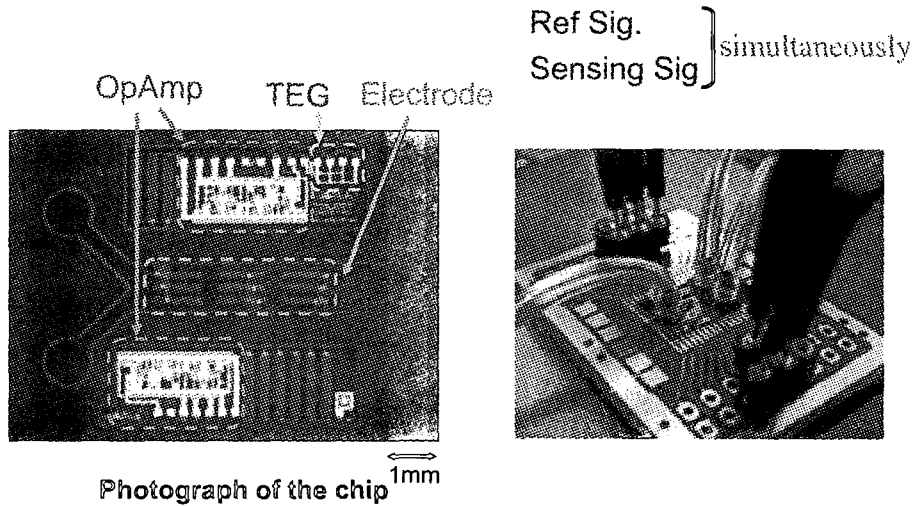
## Design OpAmp



Parameter	Simulation
Open loop gain	71dB
Input Offset Voltage	1.11mV
Source Voltage	+5V,-5V

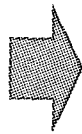


## Fabricated Device



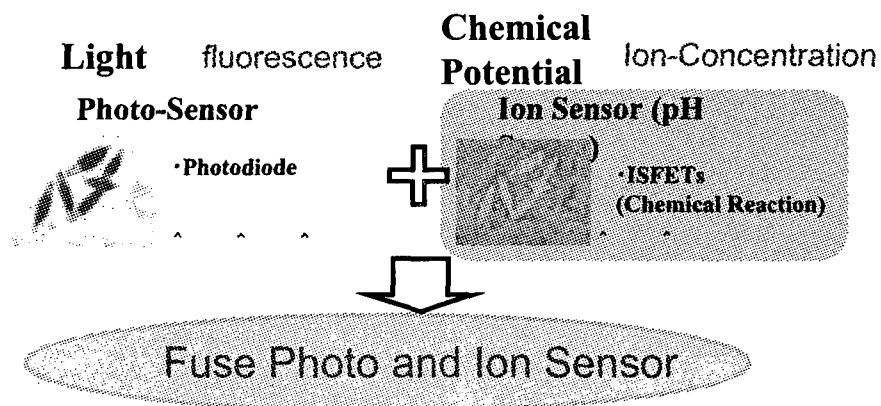
## Conclusions

- successfully fabricate micro-fluidic type electrochemical DNA sensor
- Novel DNA sensor with microfluidic type reactor used laminar flow.
- Smart microchip for DNA analysis with OpAmp



DNA analysis was carried out only electric source w/o special system.

## Fused Sensor for Chemical Analysis

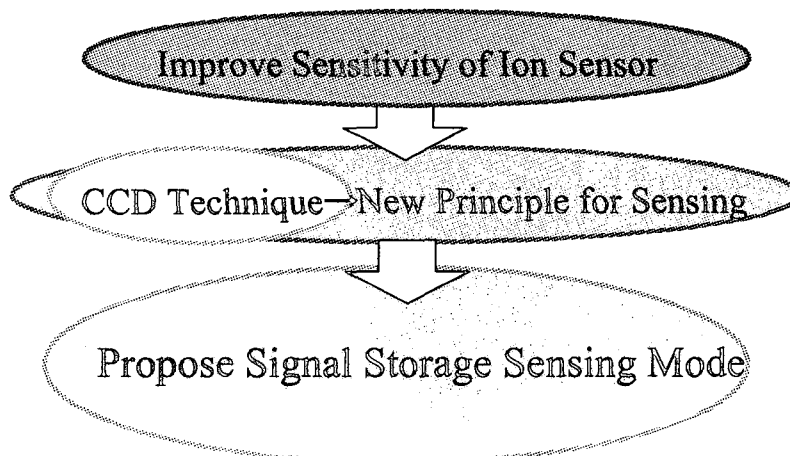




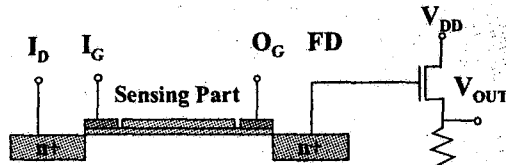
## Purpose

- Fabrication of Fused Photo- and Ion sensors using a CMOS process .

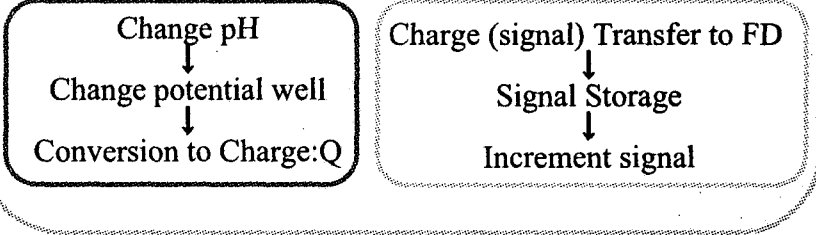
## Ion Sensor by Charge Transfer Technique



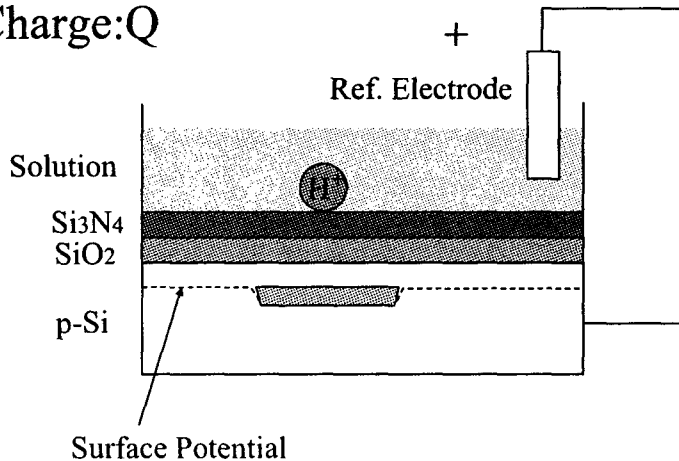
## AMIS (Accumulation Method Ion Sensor)



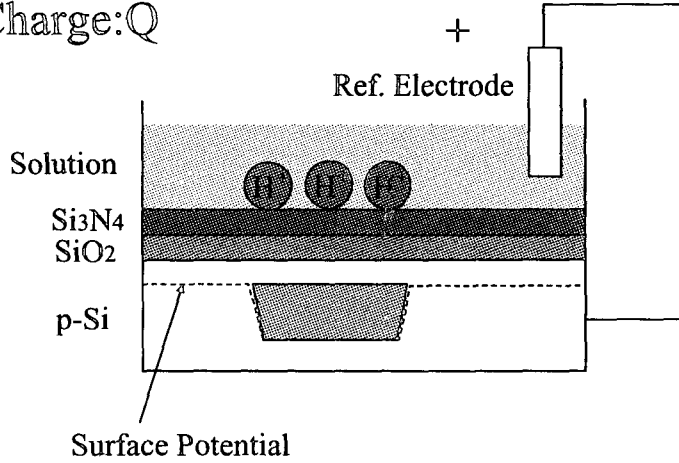
Structure: Separation pH Sensing Part and FET part



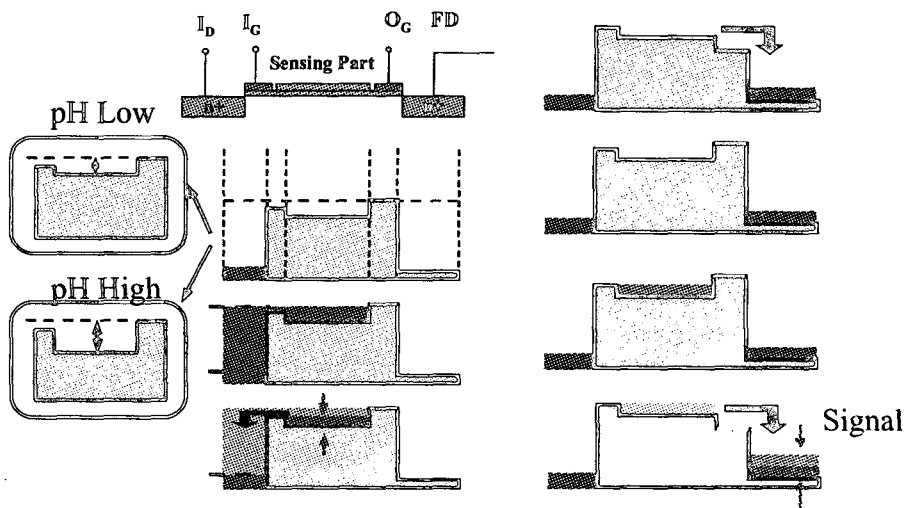
## Conversion principle from pH to Charge: Q



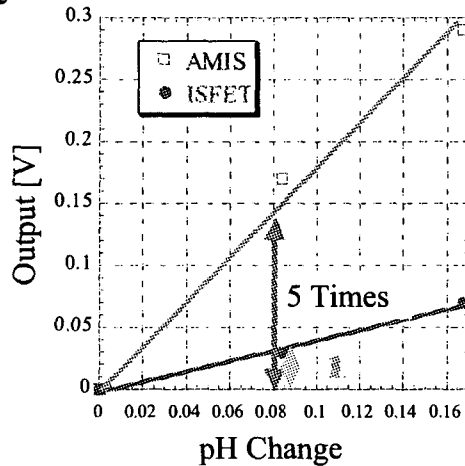
## Conversion principle from pH to Charge:Q



## New Sensing Principle using CCD Technique

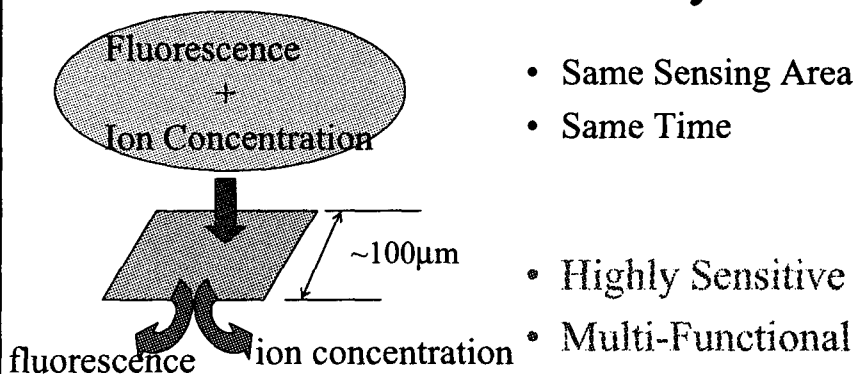


## Result

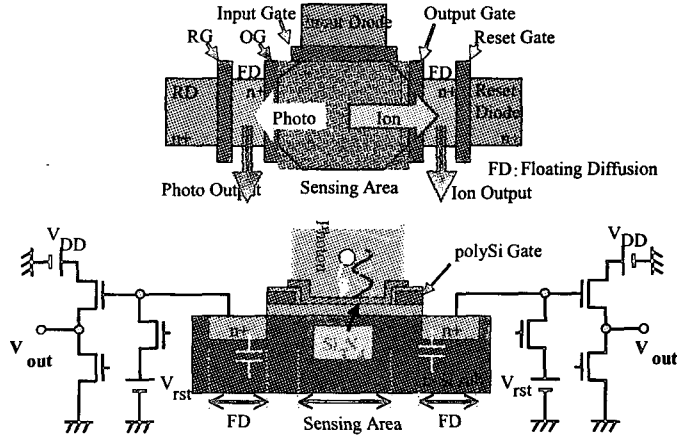


Storage Time  
=5

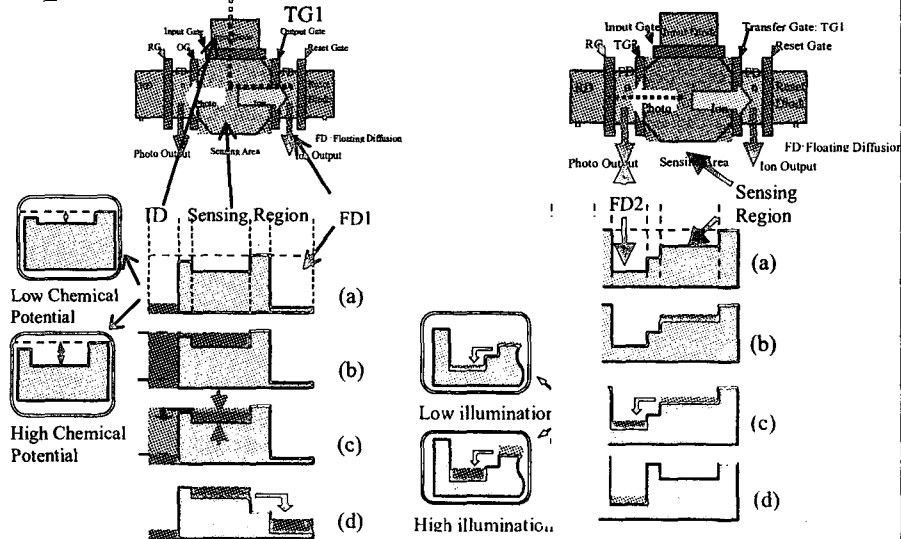
## Fused Sensor For Bio-Analysis



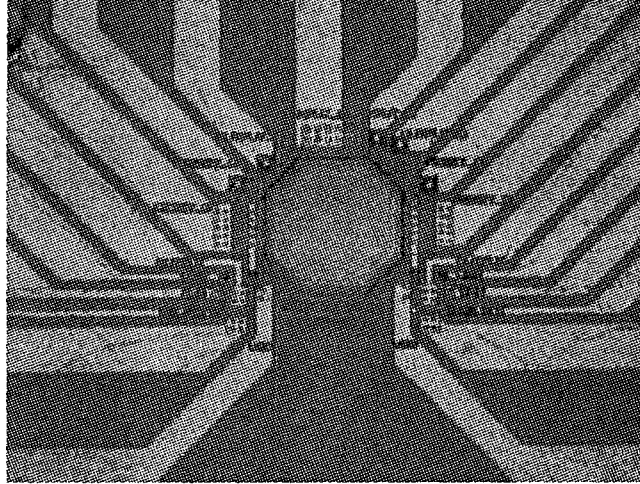
# Device Concepts



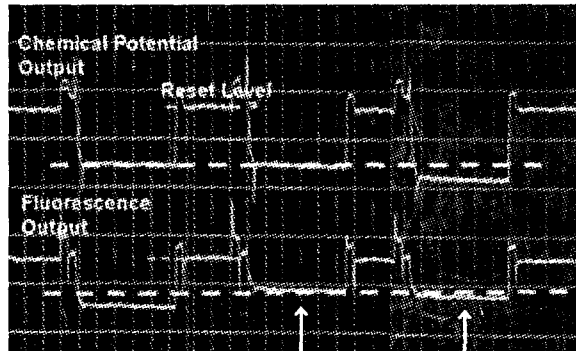
# Operation



## Fabricated Sensor by CMOS Process

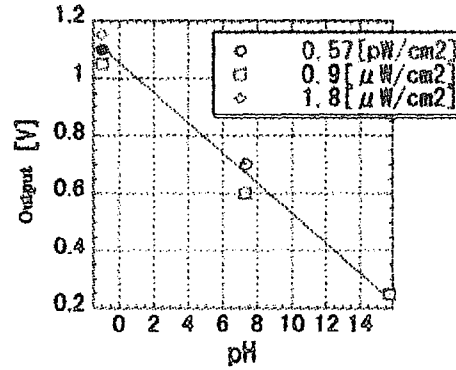
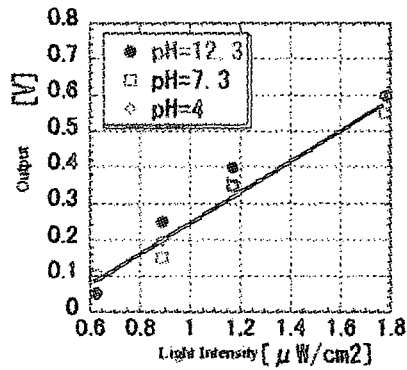


## Output Signal



**Photo-Signal and pH in same sensing area  
was measured on a same time.**

## Output Results



## Conclusions

- Novel sensor fused photo-sensor and ion sensor was proposed.
- The novel sensor was successively fabricated by CMOS processes.
- Photo-signal and Ion signal in a same sensing area was measured on a same time.