

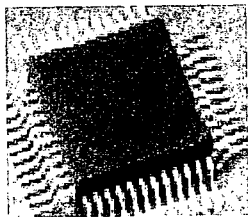
Collaborative

Biochip R & D Opportunities with HYU Micro Biochip Center

Prof. E. K. Lee
Dept. of Chemical Engineering
And
Director of Micro Biochip Center
Hanyang University
Ansan, KOREA



What is a Micro Biochip ?



Chip surface

+



Blomarker
molecules

=



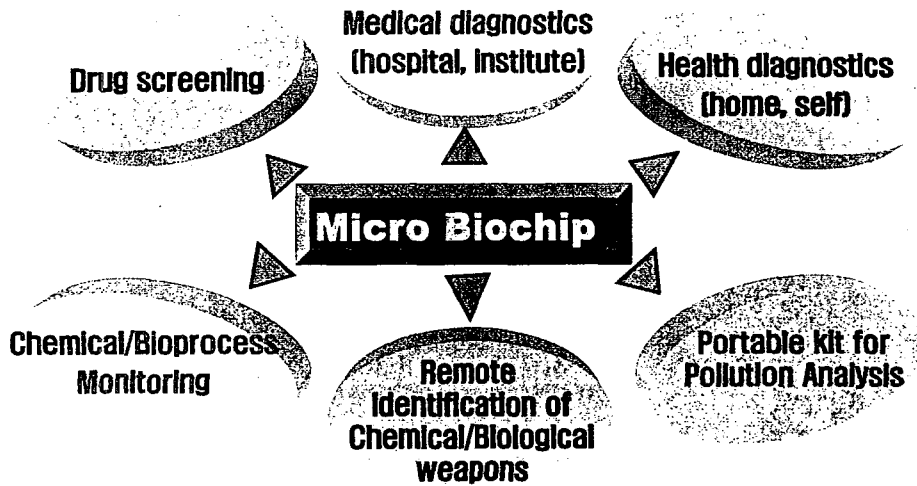
Biochip

□ BT, NT, IT Fusion Technology

□ Knowledge-based, Technology

MICRO

VARIOUS END APPLICATIONS OF MICRO BIOCHIP



MICRO
EMOTION

HANYANG UNIVERSITY MICRO BIOCHIP CENTER



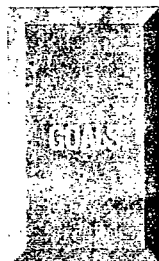
Gyeonggi Technopark
(Inside Hanyang University Ansan Campus)



14,400 ft² (Bio-foundry Clean Room (10,000 ft² + Bio Analysis/Evaluation Lab + Admin Office)



2001. 8 ~ 2006. 5 (5-year project)



- To establish a bio-foundry facility for custom-manufacturing of micro biochip products for various end applications
- To assist the biochip-related industries and entrepreneurs to design, manufacture, and evaluate their prototype products
- To incubate a core institute for academia-industry collaboration for biochip-related multidisciplinary research

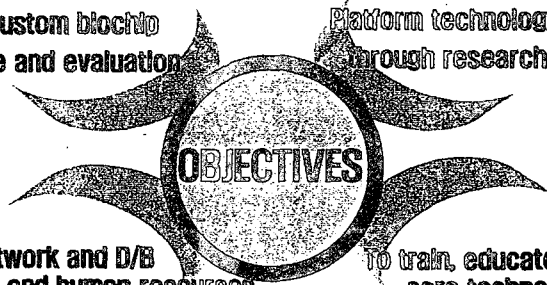
MICRO

MBC'S OBJECTIVES

"Bio-foundry" to assist micro biochip manufacturing

To assist custom biochip manufacture and evaluation

Platform technology development through research collaboration



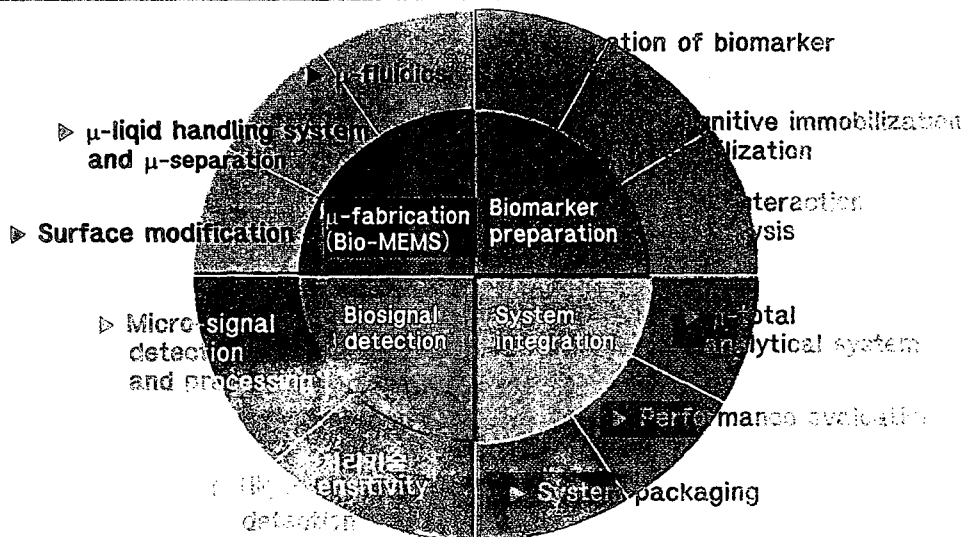
To establish network and D/B of technologies and human resources

To train, educate, and propagate core technologies

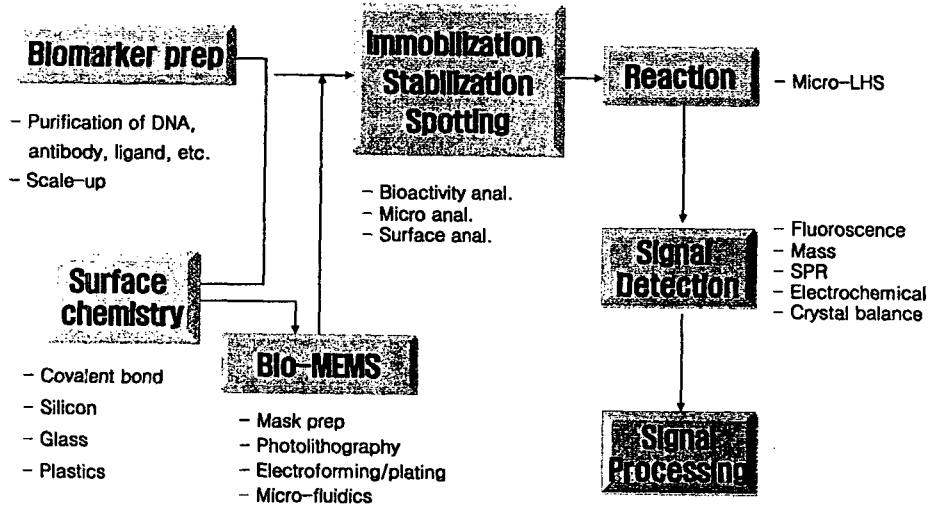
Earlier market realization of miniaturized, high-speed, multi-functional, multi-purpose biochips



CORE TECHNOLOGIES



TECHNOLOGY FLOW



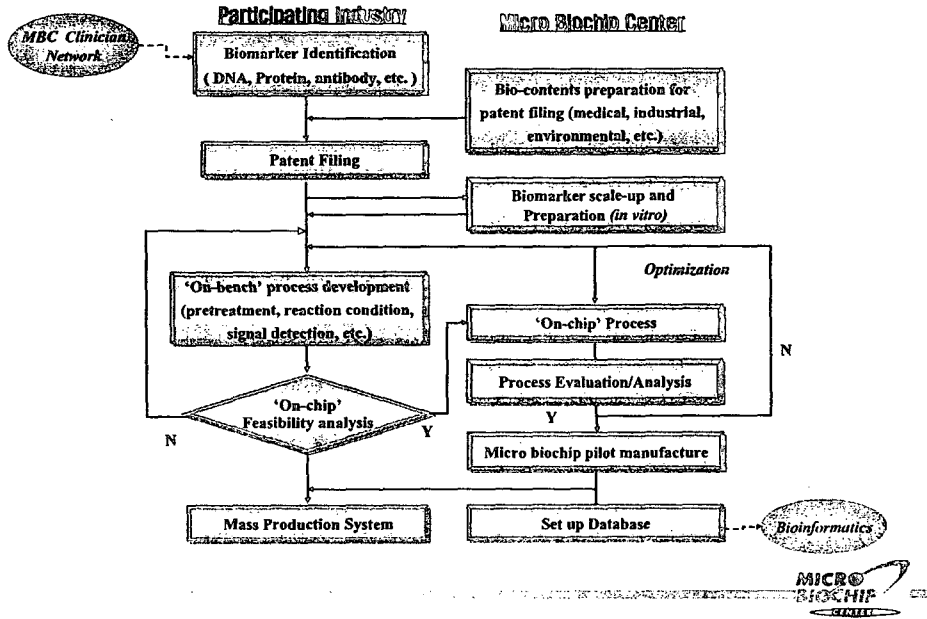
MBC's Target Technologies and Products

Bio-marker type	DNA	Protein
Integration	Microarray	Microfluidics (Lab-on-a-chip)
Applications	Medical diagnostics	Industrial (screening, monitoring, assaying)
Detection	Central	Local (point of care)

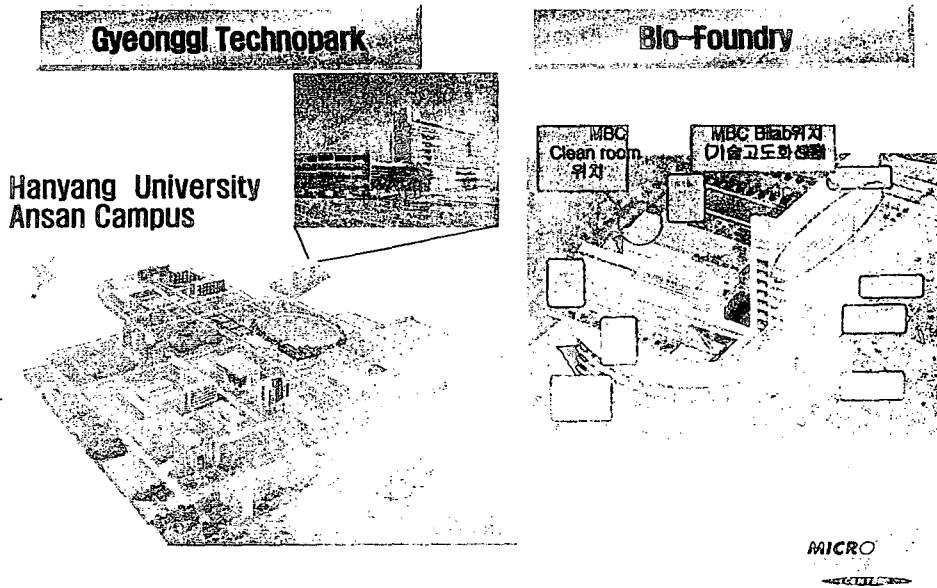
BT	NT/IT
<ul style="list-style-type: none"> - Biomarker preparation (Purification and monitoring) - Biomolecular micro-recognition - Protein profiling (sensing) and situation 	<ul style="list-style-type: none"> - Non-silicon substrates (glass, plastics) - Nano imprinting - Micro-fabrication of glass and plastics - Microfluidics design, analysis, standardization - Mask fabrication using micro picturing



BUSINESS FLOW



Bio-Foundry Location



Bio-Foundry Opening (Oct. 31, 2003)

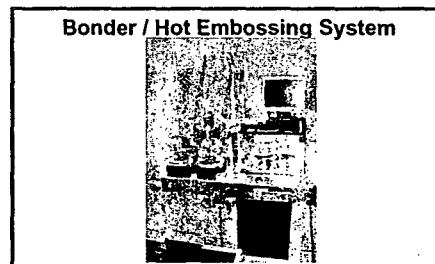


IT Equipments



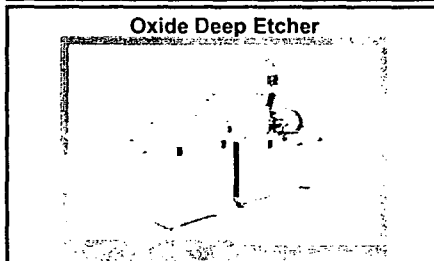
Mask Aligner

용도 : Mask 및 Wafer Aligner



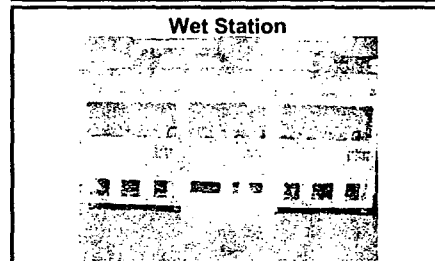
Bonder / Hot Embossing System

용도 : Substrate(Si, glass) 간 bonding



Oxide Deep Etcher

용도 : Si 산화막 및 PR 등을 원하는 깊이로 식각하는 장비



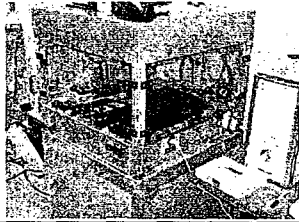
Wet Station

용도: 습식 세정 및 습식 식각용 장비

MICRO

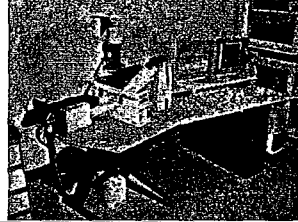
BT Equipments

Microarrayer System



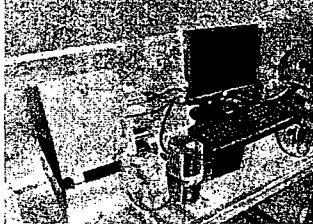
용도 : 세포로부터 추출된 DNA를 슬라이드 위에 상는 장치

Confocal Microscope



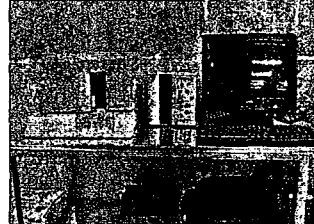
용도 : 마이크로 바이오칩의 이미지 분석 및 데이터 처리

Quartz Crystal Microbalance



용도 : 수정표면에서의 물질량 측정 및 물질 양상 측정

Luminex



용도 : 다종의 microbead를 이용한 생체물질의 다중분석

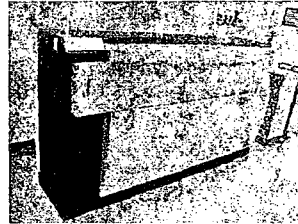
BT Equipments

SPR



용도 : 생체물질의 활성 및 kinetics양상을 측정

MALDI TOF



용도 : protein, peptide, DNA 등의 분자량을 고속 측정

PrepHPLC



용도 : 생체 고분자 물질에 대한 최적화된 분리 정제

ESI/Ion trap



용도 : 혼합물에서부터 성분 단백질이나 DNA를 분리, 1차 구조를 MS/MS기능으로 분석할 수 있는 장비로

Industry Consortium (3rd-Year)

	Name	Area		Name	Area
1	SAIT	Blochips	10	E&B Nanotech	Nano-pore particles
2	Bionics System	Bioinformatics	11	Proteogen	Protein chips
3	Allmedicus	Diagnostic kits	12	Celltech	Photodiode sensors
4	Nuricell	Activated glass chips	13	Ace Lab	SC surface
5	SEO	SC surface	14	Geegene Science	DNA chips
6	Blocore	Clinical diagnostics	15	Boditech Med	DNA chips
7	GenoCheck	DNA chips	16	Proteonics	Proteomics
8	Miwon, Inc.	Functional cosmetics	17	SJ Biomed	Immuno kits
9	DI Biotech	Bioinstruments	18	Bloneer	Reagents/Chips



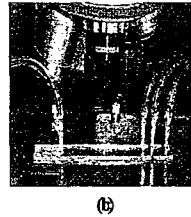
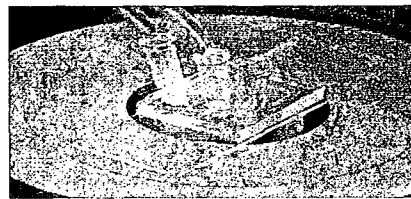
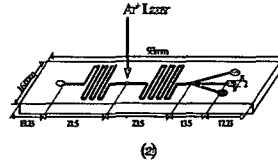
INTERDISCIPLINARY R & D TEAM

Name	Department	R & D area
Lee, E. K.	Chemical Eng.	Protein prep/immobilization
Chai, Y. G.	Biochemistry & Mol. Biol.	Protein chip
Oh, H. G.	Applied Physics	Lithography
Park, J. G.	Material Sciences	Semiconductor surface chemistry
Ahn, Y. M.	Mechanical Eng.	Bio-MEMS
Cho, N. G.	Mechanical Eng.	Microfabrication
Hwang, S. Y.	Biochemistry & Mol. Biol.	DNA chip
Lee, D. H.	Mechanical Eng.	Microfluidics simulation/design
Kim, Y. S.	MBC R & D Director	Proteomics; mass spectrometry
Lee, J. H.	Chemical Eng.	Thin film
Choo, J. B.	Applied Chemistry	Bio-optics (Confocal/Raman microscopy)
Choa, Y. H.	Chemical Eng.	Nano-bio particles
Sung, G. H.	Applied Chemistry	Microfluidics; AFM, SPM
Jung, H. J.	Applied Physics	Nano patterning



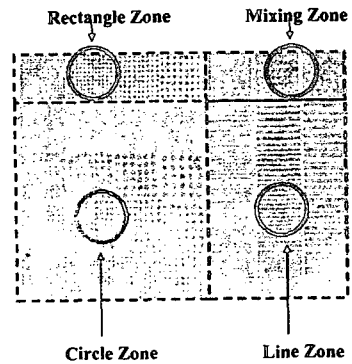
Platform Technologies in Working

❖ PDMS lab-on-a-chip fabrication



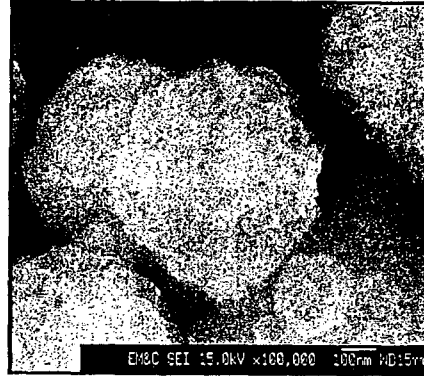
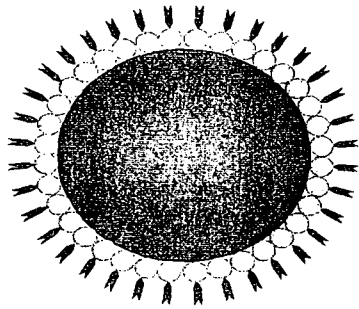
Platform Technologies in Working

❖ Surface treatment and characterization – surface modification, SAM film, nano-patterning



Platform Technologies in Working

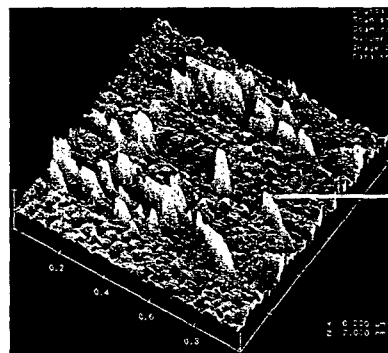
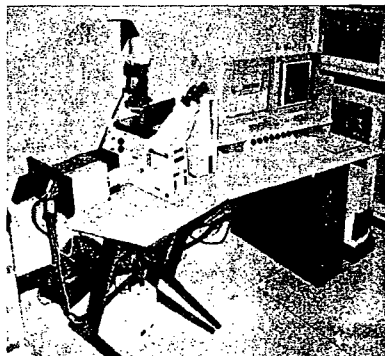
Protein Biomarker Immobilization/stabilization – using magnetic micro beads



MICRO
BIOCHIP
CENTER

Platform Technologies in Working

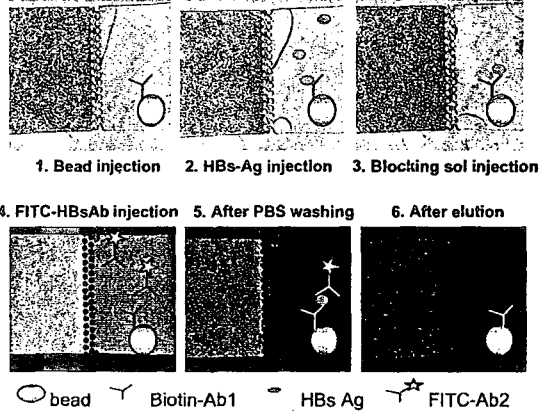
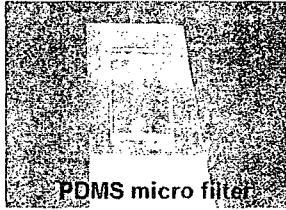
❖ Biochip reaction detection – SPR, Confocal Laser Microscopy, AFM, etc.



MICRO
BIOCHIP
CENTER

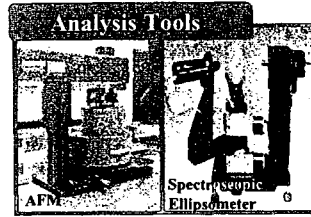
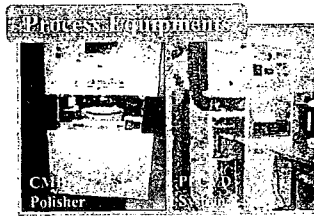
**Advanced Proteome Research Laboratory
(Prof. Young-Gyu Chai)**

**• Microfilter Chip for
Bead-based Immunoassay**



**Electronic Materials and Processing Laboratory
(Prof. Jin-Goo Park)**

Cleaning / CMP / Bio-MEMS



Research Projects

❖ **Cleaning**

- EUV Mask Cleaning
- Megasonic Cleaning

❖ **Post CMP Cleaning**

- Cu and low K
- Particle removal on different thin films
- Sub-micron particle removal on wafers

❖ **CMP Process**

- Cu CMP and slurry
- W CMP slurry
- CMP Conditioner
- Effects of pad particles

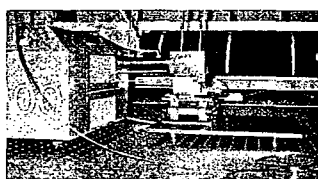
❖ **Bio-MEMS**

- Hot embossing
- Anti-stiction layer
- Wettability Evaluation
- DNA chip

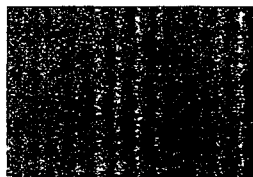
**Vacuum Ultra-Violet Lithography Lab.
(Prof. Hye-Keun Oh)**



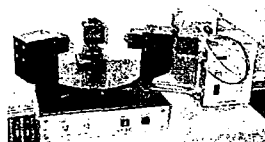
Lithography simulation



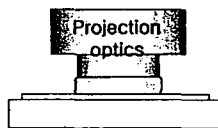
F₂ laser lithography



Interference lithography



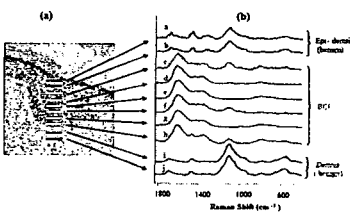
Surface Plasmon SE



Immersion lithography

**Nano-Bio Spectroscopy Laboratory
(Prof. Jaebum Choo)**

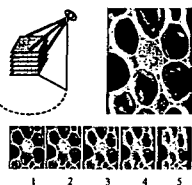
Development of Biological and Chemical Microscopy



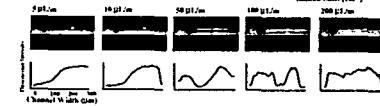
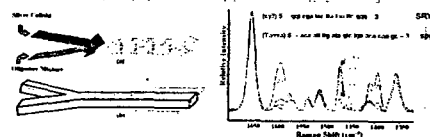
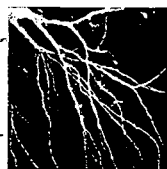
< Confocal Raman profile of skin

Development of Biological and Chemical Microscopy

1. Three-Dimensional Fluorescence Image



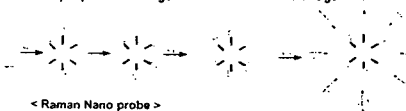
2. Neuron Image Using Depth color coding method



< Nano-prism TEM image >

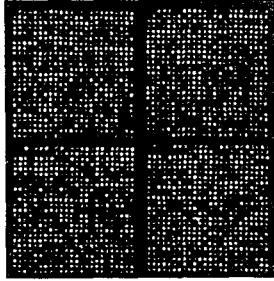


< AFM image >



< Raman Nano probe >

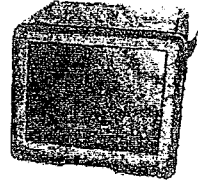
**Genomics Laboratory
(Prof. Seung-Yong Hwang)**



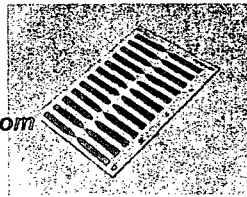
Toxicogenomics DNA chip



Lab-on-a-chip for sample preparation

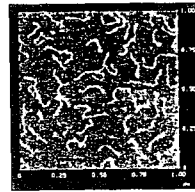
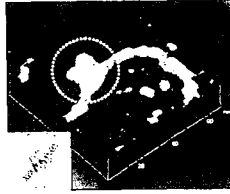
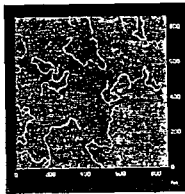


• Glass Chip for detecting an electrochemical signal from antibody-antigen reaction



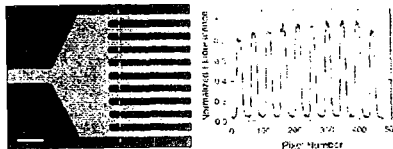
**Biochip & Nanobio Sensor Lab.
(Prof. Gi Hun Seong)**

Image analysis at nano-scale using AFM



AFM probing DNA-Protein interaction at single molecule level

Lab-on-a-chip for bioanalysis

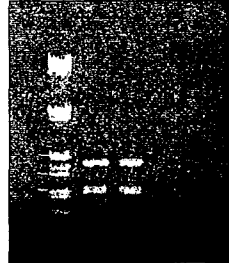
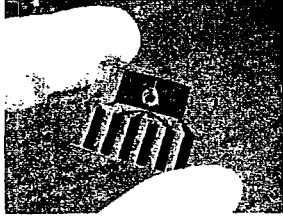


Mixing and reactions with microfluidic devices

Microfluidic devices
for protein and
enzyme assays

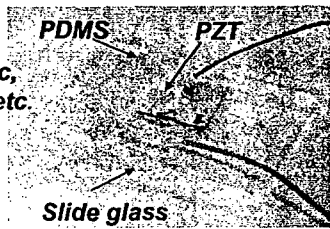
**MEMS Laboratory
(Prof. Yoomin Ahn)**

- **PDMS/glass Chip for Biochemical Reaction** (Application to PCR, Restriction Enzyme digest etc.)
- **Application to Restriction Enzyme digest**



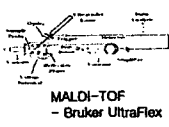
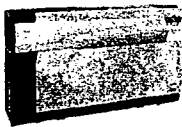
Photograph of gel electrophoresis for restriction enzyme digest
(a) by conventional method (150min)
(b) by micro reactor (10min)
(sample: pGEM[®]-4Z vector, Hind III, Sca I enzyme)

- **PDMS-based Micro Pump, Valve driven by piezoelectric, thermopneumatic actuator etc.**

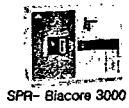


**Micro Biochip Center
(Prof. Yang Sun Kim)**

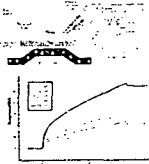
Mass spectrometry (MALDI, ESI) & Surface Modification



MALDI-TOF - Bruker UltraFlex



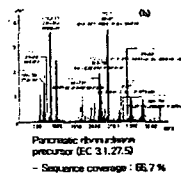
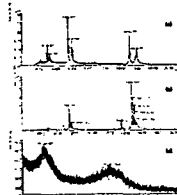
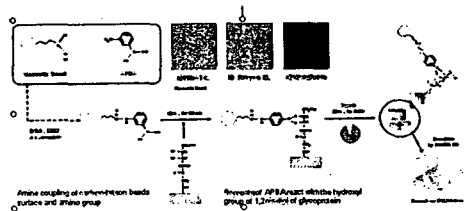
SPR - Biacore 3000



SPR sensorgram of HbA1c from PBA- Au surface

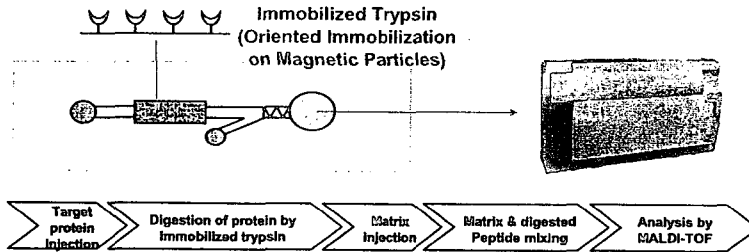


Separation of HbA1c from blood for electrochemical detection

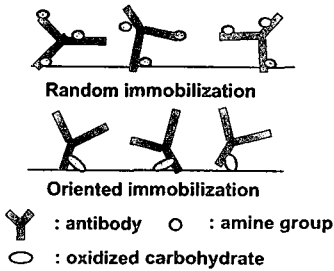


**BiProcessing Research Laboratory
(Prof. Eun Kyu Lee)**

1. Microfluidic trypsin chip (as a sample prep tandem with MALDI-TOF)



2. 'Oriented' immobilization of protein biomarkers for high-sensitivity



Immobilization method	Anti-IgG (ligand) immobilization (µg/mg MIP)	IgG (capture) adsorbed (µg/mg MIP)	Specific Binding selectivity
Random	31.9±6.9	28.2±9.5	0.9
Oriented	35.7±2.9	56.3±5.8	1.5

Next-Generation National Growth Engine Industries (BT area)

New Bio-drugs

Artificial Organs

New Drug Candidates Screening Platform

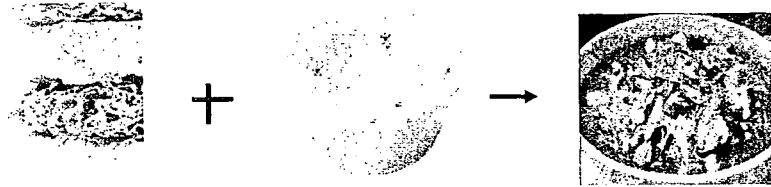
Evaluation Protocols for Biocompatibility, Toxicity Appraisal

Blochips

HJU was selected as the Principal Investigator for 'Blochip' Research



Micro Biochip ?



BT

NT

NBT



MICRO BIOCHIP CENTER,

A FRONTIER OF BNT KOREA !

