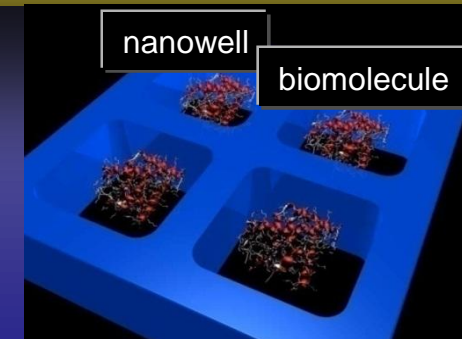


# Digitized Nanobiomedical Devices Using Nanowell Array Electrode

HeaYeon Lee

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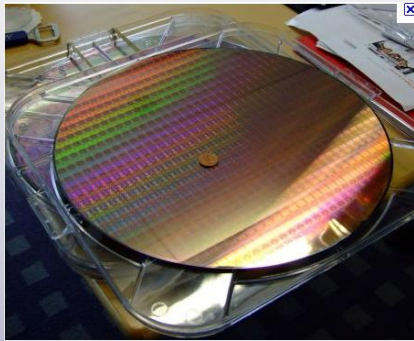


# Osaka University - Northeastern University

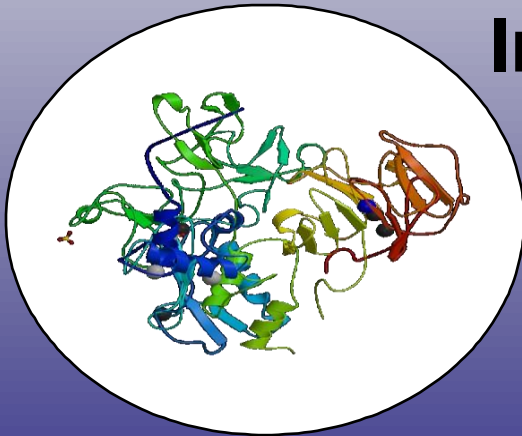


# Toward Mimicking Human Cell on a Chip

## Top-down Nanotechnology

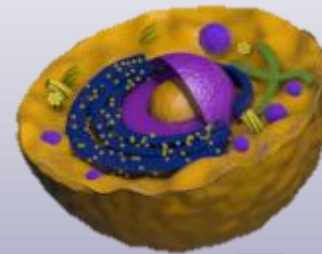


+

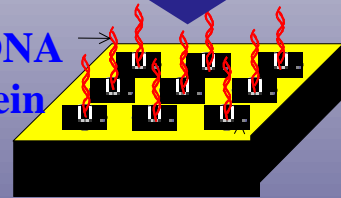


Integration

Human Cell



DNA  
Protein



***Nanobiomedical device***

## Bottom-up Nanotechnology

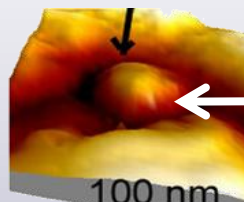
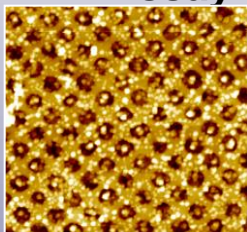
# Toward Digitized Nanomedical Device

## Nanoprocess engineering

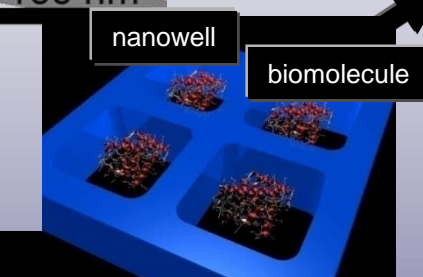
Nano-imprint Litho.

Highly Site-Selective, Specific Protein Assay

Highly Sensitive DNA Assay



Single liposome (50 nm)

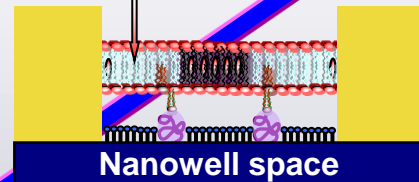


nanowell

biomolecule

Advanced nanobiodevice

Artificial cell membrane nanoarray



Nanowell space

H.Y.Lee *et,al*  
Small (2008)  
Lab on a chip(2009)

Lipid Raft,  
Liposome

Protein  
(*obesity*),  
Aptamer

Ab-Ag  
DNA

H.Y.Lee *et,al*  
Advanced Materials(2008)-Highlight,  
Biosensor and bioelectronic(2007)

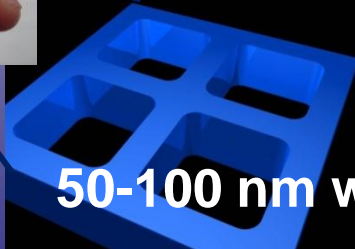
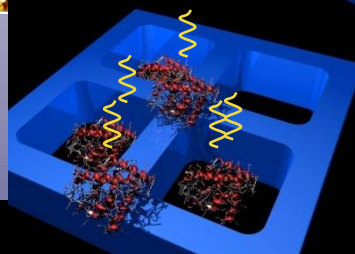
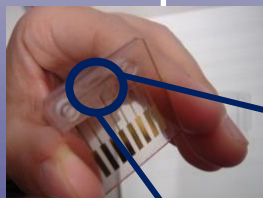
H.Y.Lee *et,al*  
Lab on a chip(2006),  
APL(2006)  
JACS (2005)  
Langmuir(2005),

50-100 nm well array

Patent 2003-403398

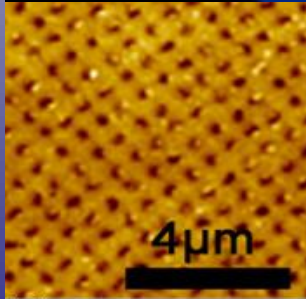
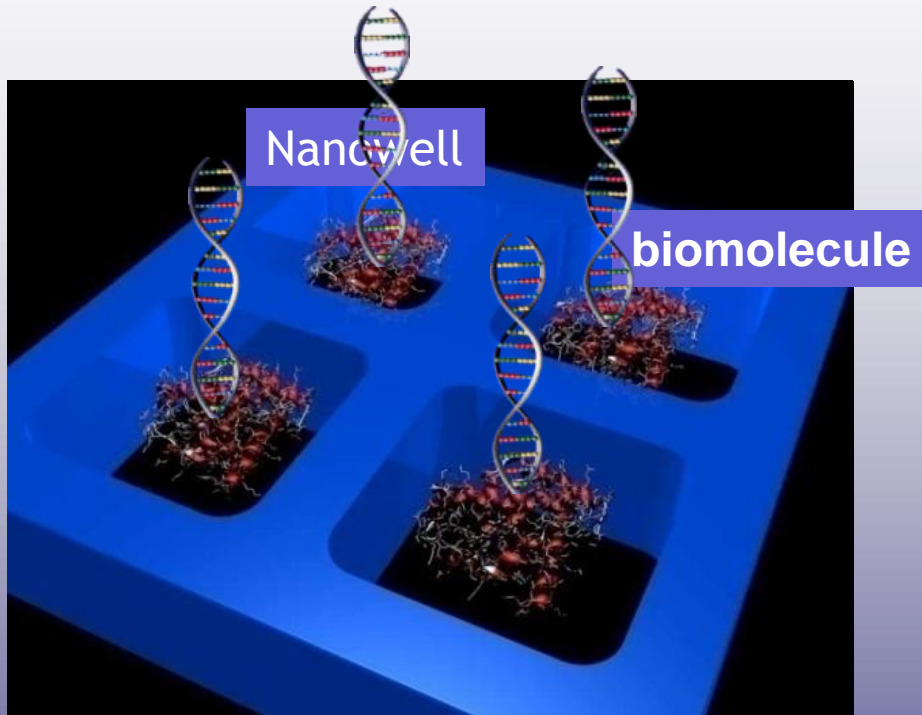
Bioanalytical Chemistry

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011  
Time



# Basic Concept of My Research

Control of individual molecular reactions in confined nanospace



## Nanowell Array

For putting biomolecules at designated positions within the nanoscale-sized wells

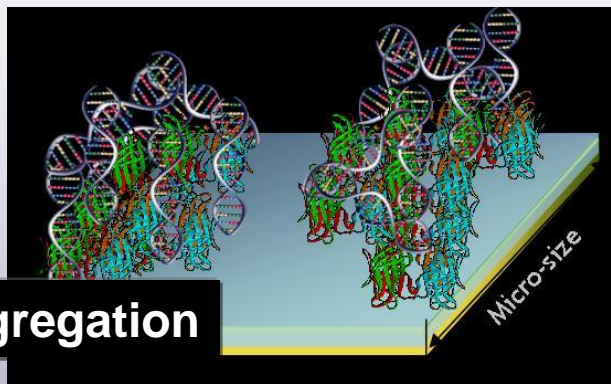


Highly sensitive, selective and specific biosensors for biomolecular analysis

H.Y.Lee et,al JACS (2005), Langmuir (2005), Lab on a chip (2006), Appl.Phys.Lett. (2006), Advanced Materials (2008)-The Highlight, Small (2008)  
H.Y.Lee et.al.Japanese Patents 3972096 (2008); 4324707 (2009); 4497903 (2009)

# Advantages of Nanowell (NW) Arrays

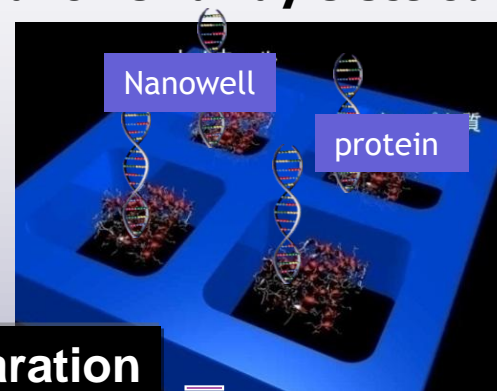
## Traditional microelectrode



Low S/N ratio

- The scale difference between micro-electrodes and molecules is tremendous.
- Background noise from electrode surface is therefore significant.

## Nanowell array electrode



separation

High S/N ratio

- Background noise can be dramatically reduced.
- Can magnify signal for statistical reliability.
- Can be combined with other electrocatalytic processes to magnify the signal further.

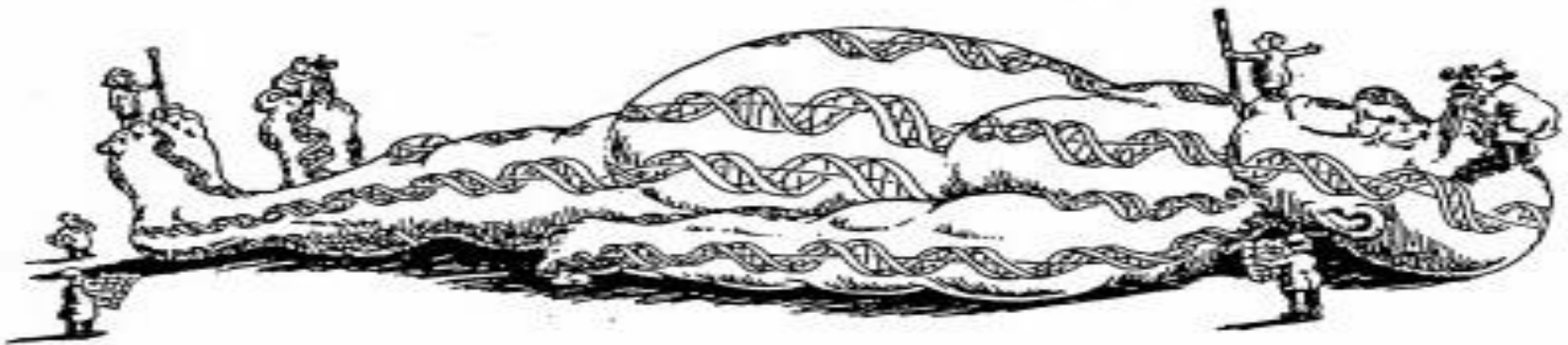
H.Y.Lee et,al  
Japanese Patent 3972096(2008),  
Japanese Patent 4324707(2009),  
Japanese Patent 4497903(2009)

## Highly sensitivity by chemical reaction control

# Conclusion

## ***Digitized nanobiomedical device based on nanowell array***

can be easily extended to detection of other materials  
and integrated with analytical devices  
on planar semiconductor substrates



***toward personalized nanomedicine***