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Research Keyword

“MEMS/NEMS system” – Micro/nano electromechanical systems design, fabrication & analysis

“BioMEMS” – Lab-on-a-chip for point of care system

“Nano-mechanics” - Cantilever biosensor system, nano bio-detection system

“Nano-fluidics” – Biological amplifier system, Bio-logic system

EDUCATION & EXPERIENCES

8/2005 to present | Postdoctoral Associate in Electrical Engineering and Computer Science,
Massachusetts Institute of Technology (**MIT**), USA

8/2004 to 7/2005 | Postdoctoral Associate in Microsystem Research Center,
Korea Institute of Science and Technology (**KIST**), South Korea

3/1999 to 8/2004 | Ph.D. in Ceramic Engineering, **Yonsei University**, South Korea
Advisor: Ki Hyun Yoon and Tae Song Kim (Co-advisor)

Thesis: PZT nanomechanical cantilever studies for protein detection system

3/1997 to 2/1999 | M.S. in Ceramic Engineering, **Yonsei University**, South Korea

3/1993 to 2/1997 | B.S. in Ceramic Engineering, **Yonsei University**, South Korea

Research Activity and Project Experience

8/2005 to present |

Micro/Nanofluidic BioMEMS Lab.

Research Laboratory of Electronics in Massachusetts Institute of Technology (**MIT**).

Research Topics:

Topic 1. Simple and efficient nanofluidic devices using junction gap breakdown & direct patterning for nanochannel fabrication for PDMS preconcentration

Topic 2. Integration of nanofluidic protein preconcentration and MALDI/MS

Topic 3. Monitoring low-abundance enzyme activity by preconcentration and reaction in micro/nanofluidic device

Topic 4. Physical studies of nanofluidic channel

Granted by NIH (National Institute of Health), NSF and Dupont Project, USA

7/2004 to 7/2005 |

Microsystem Research Center in Korea Institute of Science and Technology (**KIST**).

Research Topics: Development of micro analytical system for blood diagnostics

Granted by MOST (The Korea Ministry of Science and Technology)

*This research is **core topics of 21st century's Frontier R&D Projects**, national project scheduled for 10 years from 4/2000 to 3/2010*

4/2000 to 6/2003 |

Microsystem Research Center in Korea Institute of Science and Technology (**KIST**).

Research Topics: Development of micro-detectors using functional thin film

Granted by MOST (The Korea Ministry of Science and Technology)

*This research is **core topics of 21st century's Frontier R&D Projects**, national project scheduled for 10 years from 4/2000 to 3/2010*

10/1998 to 9/2001 |

Microsystem Research Center in Korea Institute of Science and Technology (**KIST**).

Research Topics: Development of the low temperature firing process and its application technology of piezoelectric thick film,

Granted by MOCIE (Ministry of Commerce, Industry and Energy) and MOST (The Korea Ministry of Science and Technology)

5/1997 to 2/1999 |

Multifunctional Ceramics Research Center in Korea Institute of Science and Technology (**KIST**).

Research Topics: Nano ceramic processing for biomaterials,

Granted by the Korea Ministry of Science and Technology

Training/collaboration for research

11/2005 to 4/2006 |

Microsystem Technology Laboratories (MTL) user operation (Most of equipment)

Course for COMSOL Multiphysics user training

MIT, USA

5/2004 to 5/2004 |

Course for MEMCAD user training
Organized by Dabantech., KIST, Korea

6/2000 to 7/2000 |

Course for semiconductor processing
Inter-university semiconductor research center (ISRC) in Seoul National University, Korea

7/1997 to 8/1997 |

Applied physics division
Commonwealth Scientific and Industrial Research Organisation (**CSIRO**), Australia
Topics: Nano indentation for nano ceramic sheet properties

Technical skills

NEMS/MEMS device design, fabrication, characterization

"I have extensive understanding and hands-on micro/nanofabrication experience, especially using functional materials, with a broad range of MEMS/NEMS process technologies, including nano-mechanical sensor and nano-fluidics system"

A. Design and simulation tools |

Design | AUTOCAD, L-Edit (Mask layout)

Simulation | Coventorware, FEMLAB (Multiphysics modeling), Origin

B. MEMS fabrication and material & device characterization |

Photolithography | Aligner [MA6, EV1, MJB21], I-stepper (Nikon)

Metallization | E-beam evaporator (Au, Cr, Al), RF and DC sputtering (Pt, Ta, Ti, TiO₂, PZT)

Etching & Deposition | RIE etching using Plasma Therm 790 Series (SiO₂, SiN_x, Pt etc.) and Ion milling (Pt), STS Si etching, LPCVD (SiN_x, Poly-Si, SiO₂), PECVD (SiO₂, SiN_x), Sol-gel derived deposition method for functional films (PZT thin film), STS (deep RIE), AME5000(Si/SiN_x etching for nanogap), Parylene deposition, Anodic bonding (EV501), glass-glass bonding

Soft lithography | SU8 negative PR formation, PDMS Microchannel formation, Micro/nanochannel fabrication using buckling effect

Metrology | Scanning electron microscopy(SEM), Surface profiler (Alpha step), Dektak, laser profiler, Atomic force microscope(AFM), contact angle measurement

Characterization | XRD, Raman, XPS, P-E (RT66A), I-V (HP4145), C-V (HP4280, HP4284), C-F(HP4194A), TF analyzer, HP-Impedance analyzer (HP4294), Piezoelectric constant measurement system, PSI-AFM, ZEISS-Confocal microscope, Lecroy Oscilloscope, Laser vibrometer, Q controller, PSD Sensor circuit and acquisition technique, fluorescence Microscope (Olympus)

C. Computer skills |

OS, office | windows XP, MS office, Hanword

Graphic tools | Adobe photoshop for 2D modeling, 3D Max & Rhinoceros for 3D modeling

ACADEMIC ACTIVITIES

- Author/Co-author of 1 book and over 20 technical publications.
- Holder of 3 issued patents and 2 provisional/pending patents.

INTERNATIONAL JOURNAL (SCI Journal) (in reverse chronological order) (IF~ the Impact factor of 2005)

1. **Jeong Hoon Lee**, Seok Chung, Sung Jae Kim, Jongyoon Han, "Novel PDMS Based Protein Preconcentration using a Nanogap Generated by Junction Gap Breakdown," Anal. Chem. **2007**, (accepted). **(IF~5.635)**
2. Sung Jae Kim, Ying-Chih Wang, **Jeong Hoon Lee**, Hongchul Jang, Jongyoon Han, "Concentration polarization and nonlinear electrokinetic flow near a nanofluidic channel" PHYS. REV. LETT (accepted), **2007. (IF~7.489)**
3. Kyo Seon Hwang, Sang-Myung Lee, Kilho Eom, Jeong Hoon Lee, Yoon-Sik Lee, Jung Ho Park, Dae Sung Yoon and Tae Song Kim, "Nanomechanical Microcantilever Operated in Vibration Modes with Use of RNA Aptamer as Receptor Molecules for Label-Free Detection of HCV Helicase" Biosens. Bioelectron. (in print), **2007. (IF~3.463)**
4. Hyuk-Sung Kwon, Ki-Cheol Han, Kyo Seon Hwang, **Jeong Hoon Lee**, Tae Song Kim, Dae

Sung Yoon, Eun Gyeong Yang, "Development of a peptide inhibitor-based cantilever sensor assay for cyclic adenosine monophosphate-dependent protein kinase" *Analytica. Chimica. Acta.* 585, 344-349, **2007. (IF~2.76)**

5. Kyo Seon Hwang, Kilho Eom, **Jeong Hoon Lee**, Dong Won Chun, Byung Hak Cha, Dae Sung Yoon, Tae Song Kim, Jung Ho Park, "Surface stress driven by biomolecular interactions dominated the dynamical response of nanomechanical microcantilevers" *Appl. Phys. Lett.* 89, 173905, **2006. (IF~4.127)**

6. Dong Won Chun, Kyo Seon Hwang, **Jeong Hoon Lee**, Kilho Eom, Byung Hak Cha, Woo Young Lee, Dae Sung Yoon, Tae Song Kim "Detection of the AU thin-layer in the femto-gram per Hz regime based on microcantilevers" *Sens. Actuat. A-Phys.* 2007, 135(2) 857-862 **(IF~1.363)**

7. **Jeong Hoon Lee**, Kyo Seon Hwang, Jaebum Park, Ki Hyun Yoon , Dae Sung Yoon, and Tae Song Kim, "Immunoassay of prostate-specific antigen (PSA) using resonant frequency shift of piezoelectric nanomechanical cantilever" *Biosens. Bioelectron.* 20, 2157-2162, **2005. (IF~3.463)**

8. J. W. Seong, K. W. Kim, Y. W. Beag, S. K. Koh, K. H. Yoon, **J. H. Lee**, "Effects of ion bombardment with reactive gas environment on adhesion of Au films to Parylene C film," *Thin solid films*, 476 386-390, **2005. (IF~1.569)**

9. **Jeong Hoon Lee**, Tae Song Kim, Ki Hyun Yoon, "Effect of mass and stress on resonant frequency shift of functionalized PZT thin film microcantilever for the detection of C reactive protein," *Appl. Phys. Lett.*, **84**(16), 3187-3189, **2004. (IF~4.127)**

- has been selected for *Virtual Journal of Nanoscale Science & Technology*, **9**(16), (2004).

- Also, has been selected for *Virtual Journal of Biological Physics Research*, **7**(8), (2004).

10. Kyo Seon Hwang, **Jeong Hoon Lee**, Jaebum Park, Dae Sung Yoon, Jung Ho Park, and Tae Song Kim, "In-situ quantitative analysis of prostate-specific antigen (PSA) using nanomechanical PZT cantilever in liquid cell," *Lab. Chip.* 4, 547 - 552, **2004. (IF~5.265)**

- has been selected for *Hot Article of Lab on a chip*.

11. **Jeong Hoon Lee**, Ki Hyun Yoon , Kyo Seon Hwang , Jaebum Park, Seyoung Ahn, Tae Song Kim, "Label free novel electrical detection using micromachined PZT monolithic thin film cantilever for the detection of C-reactive protein," *Biosensor and bioelectronics* 20(2), 269-275,

2004. (IF~3.463)

12. **Jeong Hoon Lee**, Kyo Seon Hwang, Ki Hyun Yoon, Tae Song Kim, and Saeyoung Ahn, "Microstructure and Adhesion of Au Deposited on Parylene-c Substrate With Surface Modification for Potential Immunoassay Application," IEEE T. Plasma Sci., 32(2), 505-509, **2004**. (IF~1.143)

13. **J. H. Lee**, K. S. Hwang, J. W. Seong, K. H. Yoon, T. S. Kim, and S. Ahn, "Microstructure and adhesion promotion of Au films on parylene-c substrates using surface modification" J. Korean. Phys. Soc., **44**(5), 1177-1181, **2004**. (IF~0.828)

14. Kyo Seon Hwang, **Jeong Hoon Lee**, Inho Han, Joo Hyon Noh, Jung Ho Park, and Tae Song Kim, "Effect of atmosphere plasma treatments for enhancing adhesion of Au on parylene-c coated protein chip," J. Korean. Phys. Soc., **44**(5), 1168-1172, **2004**. (IF~0.828)

15. **Jeong Hoon Lee**, Ki Hyun Yoon, Tae Song Kim, "Characterization of Resonant Behavior and Sensitivity using Micromachined PZT Cantilever," Integrated Ferroelectrics, **2002**, vol. 50, pp. 43-52. (IF~0.345)

16. **Jeong Hoon Lee**, Ki Hyun Yoon, Tae Song Kim, "Electric and Longitudinal Piezoelectric Properties of PZT(52/48) Films as a Function of Thickness Prepared by Diol Based Sol-gel Method," Integrated Ferroelectrics, vol. 41, pp. 119-128 **2001**. (IF~0.345)

- Submitted/ In preparation

17. **Jeong Hoon Lee**, Kyo Seon Hwang, Ga Young Han, Dae Sung Yoon and Tae Song Kim, "Protein dynamics enhance the sensitivity of microcantilevers" NAT. BIOTECHNOL. **2007**, submitted (IF~22.38)

18. **Jeong Hoon Lee**, Tae Song Kim, Ki Hyun Yoon "Macro/micro-stress relaxation effect to preferred orientation and piezo response of $\text{Pb}(\text{Zr}_{0.52}\text{Ti}_{0.48})\text{O}_3$ films with the increase above submicron thickness," J. Appl. Phys. **2007**, (to be submitted). (IF~2.5)

19. Seok Chung, **Jeong Hoon Lee**, Moungh-Woon Moon, Jongyoon Han, Roger D. Kamm, "Fabrication of Nanofluidic Channels with directed wrinkling patterns," Nano Lett. **2007**, submitted. (IF~9.847)

DOMESTIC JOURNAL

3 domestic papers were published.

Book/Chapter in Books

1. Tae Song Kim, **Jeong Hoon Lee**, and Dae Sung Yoon “Nanomechanical cantilever devices for biological sensors” in *Micromanufacturing and Nanotechnology*, Ed. N. P. Mahalik (ISBN 3-540-25377-7 Springer Berlin Heidelberg New York, 2005).

PATENTS

1. **Jeong Hoon Lee**, Tae Song Kim, Dae Sung Yoon, Kyo Seon Hwang, “Method and System for detecting bio-element” 10-0583233-00-00, May. 18, 2006
2. Tae Song Kim, **Jeong Hoon Lee**, Kyo Seon Hwang, Jaebum Park, “Element detecting system using cantilever, method for fabrication of the same system and method for detecting micro element using the same system” 10-0613398-00-00, Aug. 9, 2006
3. Tae Song Kim, Hyung Joon Kim, **Jeong Hoon Lee**, Ji Yoon Kang, “Cantilever sensor and fabrication method thereof,” Publication Number: US20030224551, KR2003-0092618
4. Tae Song Kim, **Jeong Hoon Lee**, Kyo Seon Hwang, Jaebum Park, “Bioassays using PZT monolithic nanomechanical cantilever,” patent pending (2004)
5. **Jeong Hoon Lee**, Yong-Ak Song, Jongyoon Han, “*Disposable Electrokinetic Micro Preconcentrator for Proteomic Sample Preparation Using PDMS Microfluidic Chip*” in progress (MIT) (2007)

INTERNATIONAL CONFERENCE

1. **Jeong Hoon Lee**, Seok Chung, Sung Jae Kim, Jongyoon Han, “Novel PDMS based protein preconcentration using junction gap breakdown phenomena” MSB 2007: 21st International Symposium on Microscale Bioseparations, Vancouver, January 14-18, 2007, Vancouver, Canada
2. Kyo Seon Hwang, **Jeong Hoon Lee**, Dong Won Chun, Byung Hak Cha, Ga Young Gan, Eun Gyeong Yang, Jung Ho Park, Dae Sung Yoon, Tae Song Kim, “Peptide based protein kinase detection using a nanomechanical dynamic microcantilever” MicroTAS 2006, The Tenth International Conference on Miniaturized Chemical and BioChemical Analysis Systems, November 5-19 2006, Tokyo, Japan.

3. Sung Jae Kim, Ying-Chih Wang, Hongchul Jang, **Jeong Hoon Lee**, and Jongyoon Han, "NONLINEAR ELECTROKINETIC FLOW PATTERN NEAR NANOFUIDIC CHANNEL" MicroTAS 2006, The Tenth International Conference on Miniaturized Chemical and BioChemical Analysis Systems, November 5-19 **2006**, Tokyo, Japan.
4. K. S. Hwang, **J. H. Lee**, D. W. Chun, G. Y. Han, D. S. Yoon, J. H. Park, T. S. Kim, "Biodetection and Quantitative Analysis of Myoglobin Using Higher Mode Resonance of Nanomechanical Piezoelectric Cantilever" Biosensors **2006**, The Ninth World Congress on Biosensors, May 10-12 2006 in Toronto, Canada.
5. K. S. Hwang, S. M. Lee, **J. H. Lee**, D. W. Chun, G. Y. Han, Y. S. Lee, D. S. Yoon, J. H. Park, T. S. Kim, "Highly Sensitive RNA Aptamer Immobilized Dynamic Self-exciting Nanomechanical Cantilever for Hepatitis C Virus (HCV) Helicase Detection" Biosensors 2006, The Ninth World Congress on Biosensors, May 10-12 **2006** in Toronto, Canada.
6. Dong Won Chun, Kyo Seon Hwang, **Jeong Hoon Lee**, Dae Sung Yoon, Woo Young Lee, Tae Song Kim, "Ultra-High Sensitive PZT Thin Film Cantilever for Femtogram Mass Detection" ISIF 2006, The 18th International Symposium on Integrated Ferroelectrics, April 23-27, **2006** in Honolulu, Hawaii, USA.
7. **Jeong Hoon Lee**, Kyo Seon Hwang, Ga young Han, Ki Yong Choi, Dae Sung Yoon, T. S. Kim, "Femtomolar detection of prostate-specific antigen (PSA) using a dynamic self-exciting nanomechanical cantilever" MicroTAS 2005, The Ninth International Conference on Miniaturized Chemical and BioChemical Analysis Systems, October 9-13, **2005**, Boston, Massachusetts, USA.
8. H. Cho, J. Y. Kang, S. M. Kwak, K. S. Hwang, J. Min, **J. Lee**, D. S. Yoon, T. S. Kim, "Integration of PDMS Microfluidic Channel with Silicon-Based Electromechanical Cantilever Sensor on a CD-Like Chip" IEEE MEMS 2005, IEEE The Eighteenth Annual International Conference on Micro Electro Mechanical Systems, January 30-February 3, 2005 in Miami, Florida, USA.
9. **J. H. Lee**, K. S. Hwang, J. Park, D. S. Yoon, K. H. Yoon, T. S. Kim, "Immunoassay of prostate-specific antigen (PSA) using resonant frequency shift of piezoelectric nanomechanical cantilever," Biosensor and bioelectronics, The Eight World Congress on Biosensors, 24-26 May

2004 in Granada, Spain.

10. K. S. Hwang, **J. H. Lee**, J. Park, D. S. Yoon, J. H. Park, and T. S. Kim, "In-situ quantitative analysis of prostate-specific antigen (PSA) using nanomechanical PZT cantilever," Biosensor and bioelectronics, The Eight World Congress on Biosensors, 24-26 May **2004** in Granada, Spain.

11. **Jeong Hoon Lee**, Kyo Seon Hwang, Dae Sung Yoon, Ki Hyun Yoon, and Tae Song Kim, "Effects of liquid viscosity and density on resonant behavior of nano-mechanical PZT (52/48) thin film cantilever," The 16th International Symposium on Intergrated Ferroelectrics, April 5-8, **2004** in Gyeongju, Korea.

12. **J. H. Lee**, K. S. Hwang, J. Park, D. S. Yoon, K. H. Yoon, T. S. Kim, "On-line monitoring of blood viscosity using self-sensing piezoelectric microcantilever," Biosensor and bioelectronics, The Eight World Congress on Biosensors, 24-26 May **2004** in Granada. Spain.

13. **Jeong Hoon Lee** and Tae Song Kim, "Micro/nano Biosensor Technology," Nano Korea 2003 Symposium, Aug. 27-30, **2003**, ASEM HALL, COEX, Seoul, Korea, (INVITED TALK).

14. Kyo Seon Hwang, **Jeong Hoon Lee**, Jaebum Park, Jung Ho Park, and Tae Song Kim, "Protein mass detection system in liquid for prostate-specific antigen (PSA) using PDMS liquid cell by resonant frequency shift of micromachined PZT cantilever," MicroTAS2003, The 7th International Conference on Miniaturized Chemical and BioChemical Analysis Systems, October 5-9, **2003**, Squaw Valley, California USA.

15. **J. H. Lee**, K. S. Hwang, K. H. Yoon, T. S. Kim, and S. Ahn, "Improvement of Au adhesion on parylene-c and SiO₂ substrates using oxygen plasma treatment," the 30th IEEE International Conference on Plasma Science June 2-5, **2003** Jeju, Korea.

16. K.S.Hwang, **J.H.Lee**, J.H.Park, and T.S.Kim, "Effect of various surface treatment for enhancing adhesion of Au on parylene coated protein chip," International Conference on Plasma Science Abstract Submitted for the 30th IEEE International Conference on Plasma Science June 2-5, **2003** Jeju, Korea.

17. **Jeong Hoon Lee**, Kyo Seon Hwang, Jung Ho Park, Saeyoung Ahn, Ki Hyun Yoon, and Tae Song Kim, "Evaluation of Electrical Properties and Residual Stress for PZT (52/48) Films by Sol-gel Routes with Raman Spectroscopy," Integrated Ferroelectrics, The 15th International

Symposium on Intergrated Ferroelectrics, March 9-12, **2003** in Colorado Springs, Colorado, USA.

18. **Jeong Hoon Lee**, Ki Hyun Yoon, and Tae Song Kim, "Electromechanical Characteristics of Micromachined PZT Cantilever for Protein Mass Detecting System," Integrated Ferroelectrics, The 14th International Symposium on Intergrated Ferroelectrics, May 28-June 1, **2002** in Nara, Japan.

19. **Jeong Hoon Lee**, Ki-Hyun Yoon, Tae-Song Kim, "Electromechanical characterization of micromachined PZT cantilever," International Sensor Conference, October 11-12, 2001, Seoul National University, in Seoul, Korea (**2001**)- Proceeding. pp.43-44.

20. **Jeong Hoon Lee**, Ki-Hyun Yoon, Tae-Song Kim, "Electric and Longitudinal Piezoelectric Properties of PZT(52/48) Films as a Function of Thickness Prepared by Diol Based Sol-gel Method," Integrated Ferroelectrics, The 13th International Symposium on Intergrated Ferroelectrics, March 11-15, **2001** in Colorado Springs, Colorado, USA.

DOMESTIC CONFERENCE

17 domestic conferences were presented.

REFERENCES

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