BIOGRAPHICAL SUMMARY OF CHAO SUNG LAI

Chao-Sung Lai received the B. S. and ph. D. degrees from National Chiao Tung University, Hsinchu, Taiwan, in 1991 and 1996, respectively. In 1996, he joined National Nano Device Laboratories, Hsinchu, where was engaged in the research of silicon-on-insulator devices. He then, in 1997, joined Chang Gung University, Taoyuan, Taiwan, as an Assistant Professor. He was promoted to Associate and Full Professor in 2001 and 2006, respectively. He has been engaged in the research of the characterization and reliability of MOSFETs, Flash memory, high-k dielectrics, metal gates, and biosensors. From 2001 to 2002, he visited the Department of Electrical Engineering, University of California, Berkeley, for visiting research on fin-shaped FETs. Since 2007 to 2013, he had been the Chairman of the Department of Electronic Engineering and the Director of the Biosensor Group of the Biomedical Research Center, Chang Gung University, for the research-related bio-transistor application on ions, proteins, DNA, and biomarker analysis. From 2012, he is the Dean of Engineering College of Chang Gung University. He holds 9 U.S. patents and 27 Taiwan patents, and he is the author of more than 150 SCI journal papers, 200 conference papers, 12 international invited talks, and 2 book chapters. Dr. Lai is the Leading Guest Editor of the SCI journals, including Microelectronics Reliability (2010), Nano-Scaled Research Letters (2011), and Solid-State Electronics (2012), and Nano-Scaled Research Letters (2014). He won Lam Research Award in 1997 and distinguished award from Electron Devices and Materials Association in 2011.

BIOGRAPHICAL SKETCH

First NAME **Chao-Sung**	POSITION TITLE Dean, College of Engineering Professor, Department of Electronic Engineering Director, Bio-Sensor Group, Bio-Medical Research Center Chang Gung University
Family NAME **Lai**	

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
National Chiao Tung University, Taiwan	B.S.	06/91	Electronic Engineering
National Chiao Tung University, Taiwan	Ph.D.	12/96	Electronic Engineering

Positions and Employment

1996-1997	Associate Researcher, National Nano Device Laboratory, Taiwan
1997-2001	Assistant Professor, Department of Electronic Engineering, Chang Gung University
2001-2002	Visiting Scholar, University of California, Berkeley, US
2001-2005	Associate Professor, Department of Electronic Engineering, Chang Gung University
2006-now	Professor, Department of Electronic Engineering, Chang Gung University, Taiwan
2007-2013	Chairman, Department of Electronic Engineering, Chang Gung University, Taiwan
2007-now	Director, Bio-Sensor Group, Bio-Medical Research Center, Chang Gung University
2012-now	Dean, College of Engineering, Chang Gung University, Taiwan
2015-now	Adjunct Professor, Department of Materials Engineering, Ming Chi University of Technology
2016-now	Adjunct Professor, Department of Nephrology, Chang Gung Memorial Hospital, Taiwan

Editorial Experience

2010-	Leading Guest Editor, Microelectronics Reliability (2010)
2011-	Leading Guest Editor, Nano-Scaled Research Letters (2011)
	Leading Guest Editor, Solid-State Electronics (2011)
2014-	Guest Editor, Nano-Scaled Research Letters (2014)

	Guest Editor, International Journal of Nanotechnology (2014)
2015-	Guest Editor, Vacuum (2015)
2017-	Guest Editor, International Journal of Nanotechnology (2017)

Honors

2004-2005	Supervisor, Chinese Chemical Sensing Technology Association
2006	Excellence in Research, Chang Gung University, Taiwan
2006	International Electron Devices and Materials Symposia (IEDMS) best paper awards
2009	International Electron Devices and Materials Symposia (IEDMS) best paper awards
2010	International Advisory Committee: IEEE EDSSC'10
2010	Distinguish Professor Award, Chang Gung University, Taiwan
2010	Excellence in Research Award, Electronics Device and Material Association, Taiwan
2010	Director, Electronics Device and Material Association, Taiwan
2011	Excellence in Research Award, Chang Gung University, Taiwan
2015	IEEE Distinguished Lecture, ED Society (one of thirty lectures in region Asia-Pacific)
2015	Excellence in Research Award, Association of Chemical Sensors in Taiwan
2016	Board Director, Association of Chemical Sensors in Taiwan
2016	Excellence in Research Award, Chang Gung University, Taiwan

Research h-index > 24 (by Google Scholar)

Selected Publication within three years:

1. Jer-Chyi Wang, Kai-Ping Chang, Chih-Ting Lin, Ching-Yuan Su , Fethullah Günes, Mohamed Boutchich, Chang-Hsiao Chen, Ching-Hsiang Chen, Ching- Shiun Chen, Lain-Jong Li, **Chao-Sung Lai*** (2017, Mar). Integration of ammoniaplasma- functionalized graphene nanodiscs as charge trapping centers for nonvolatile memory applications. Carbon, 113,318-324. SCI IF=6.198.
2. Agnes Purwidyantri, Imène El-Mekki and Chao-Sung Lai*, "Tunable plasmonic SERS "hotspots" on Au-film over Nanosphere by Rapid Thermal Annealing" Jan 2017 · IEEE Transactions on Nanotechnology.
3. Chia-Ming Yang · Yuan-Hui Liao · Chun-Hui Chen · Tsung-Cheng Chen · **Chao-Sung Lai*** · Dorota G. Pijanowska "P-I-N amorphous silicon for thin-film light-addressable potentiometric sensors" Apr 2016 · Sensors and Actuators B Chemical. SCI IF=4.097
4. Yi-Ting Lin, Agnes Purwidyantri, Ji-Dung Luo, Chiuan-Chian Chiou, Chia-Ming Yang*, Chih-Hong Lo, Tsann-Long Hwang, Tzung-Hai Yen, and **Chao-Sung Lai*** "Programming a Nonvolatile Memory-like Sensor for KRAS Gene Sensing and Signal Enhancement" Biosensors & Bioelectronics (2016) SCI IF=6.409
5. Agnes Purwidyantri, Ching-Hsiang Chen, Bing-Joe Hwang, Ji-Dung Luo, Chiuan-Chian Chiou, Ya-Chung Tian, Chan-Yu Lin, Chi-Hui Cheng, **Chao-Sung Lai***, "Spin-coated Au-nano hole arrays engineered by nano sphere lithography for a Staphylococcus aureus 16SrRNA electrochemical sensor" Biosensors and Bioelectronics (2016) SCI IF=6.409
6. Kuan-I Ho, Mohamed Boutchich,* Ching-Yuan Su, Rosalia Moreddu, Eugene Sebastian Raj Marianathan, Laurent Montes, and **Chao-Sung Lai*** "A Self-Aligned High-Mobility Graphene Transistor: Decoupling the Channel with Fluorographene to Reduce Scattering" Advanced Materials (2015) SCI IF=17.493
7. Agnes Purwidyantri, Hsin-Chih Lai, Sheng-Hui Tsai, Ji-Dung Luo, Chiuan-Chian Chiou, Ya-Chung Tiane, Chi-Hui Chengh, Yi-Ting Lin ,**Chao-Sung Lai*** "Sensing performance of fibronectin-functionalized Au-EGFET on thedetection of S. epidermidis biofilm and 16S rRNA of infection-relatedbacteria in peritoneal dialysis" Sensors and Actuators B (2015) SCI IF=4.097
8. K.-I. Ho, J.-H. Liao, C.-H. Huang, C.-L. Hsu, W. Zhang, A.-Y. Lu, L.-J. Li, **Chao-Sung Lai***, C.-Y. Su*, "One-Step Formation of a Single Atomic-Layer Transistor by the Selective Fluorination of a Graphene Film" Small (2014) SCI IF=7.514
9. Anirban Dasa, Yen-Heng Lin*, **Chao-Sung Lai***, "Miniaturized amorphous-silicon based chemical imaging sensor system using a mini-projector as a simplified light-addressable scanning source", Sensors and

Actuators B (2014) SCI IF=3.84

10. Jer-Chyi Wang, Yu-Hsuan Lin, Yu-Ren Ye, Chao-Sung Lai*, Chi-Fong Ai and Wen-Fa Tsai "Hybrid anion and cation ion sensors with samarium oxide sensing membrane treated by nitrogen plasma immersion ion implantation", Sensors and Actuators B (2014) SCI 3.84
11. Chi-Hsien Huang, Ching-Yuan Su, **Chao-Sung Lai***, Yen-Cheng Li , and Seiji Samukawa "Ultra-low-damage radical treatment for the highly controllable oxidation of large-scale graphene sheets" CARBON (2014). SCI IF=6.16
12. Jer-Chyi Wang*, Chih-Hsien Hsu, Yu-Ren Ye, **Chao-Sung Lai***, Chi-Fong Ai, and Wen-Fa Tsai "High-Performance Multilevel Resistive Switching Gadolinium Oxide Memristors With Hydrogen Plasma Immersion Ion Implantation Treatment" IEEE Electron Device Letters, (2014) SCI IF=3.023
13. Hsiao-Chien Chen, Jian-Tai Qiu, Fu-Liang Yang, Yin-Chih Liu, Min-Cheng Chen, Rung-Ywan Tsai, Hung-Wei Yang, Chia-Yi Lin, Chu-Chi Lin, Tzong-Shoon Wu, Yi-Ming Tu, Min-Cong Xiao, Chia-Hua Ho, Chien-Chao Huang, **Chao-Sung Lai***, and Mu-Yi Hua* "Magnetic-composite-modified polycrystallinesilicon nanowire field-effect transistor for vascular endothelial growth factor detection and cancer diagnosis" Analytical Chemistry, (2014), SCI IF=5.825
14. Anirban Das, Tsung-Cheng Chen, Chia-Ming Yang*, **Chao-Sung Lai*** "A high-speed, flexible-scanning chemical imaging system usinga light-addressable potentiometric sensor integrated withan analog micromirror" Sensors and Actuators B (2014) SCI 3.84
15. Kuan-I Ho, Chi-Hsien Huang, Jia-Hong Liao, Wenjing Zhang, Lain-Jong Li, **Chao-Sung Lai*** & Ching-Yuan Su* "Fluorinated Graphene as High Performance Dielectric Materials and the Applications for Graphene Nanoelectronics" Scientific Report, 2014, SCI IF=5.078
16. Chi-Hsien Huang, Ching-Yuan Su, Takeru Okada, Lain-Jong Li, Kuan-I Ho, Pei-Wen Li, Inn-Hao Chen, Chien Chou, **Chao-Sung Lai***, Seiji Samukawa*, "Ultra-low-edge-defect graphene nanoribbons patterned by neutral beam", Carbon (2013) SCI 5.868
17. Yi-Ting Lin, Ji-Dung Luo, Chiuan-Chian Chiou, Chia-Ming Yang, Chung-Yih Wange, Chien Chou and **Chao-Sung Lai*** "Detection of KRAS mutation by combination of polymerase chain reaction (PCR) and EIS sensor with new amino group functionalization", Sensors and Actuators B: Chemical (2013) SCI IF=3.535
18. Jung-Hsiang Yang, Tseng-Fu Lu, Jer-Chyi Wang, Chia-Ming Yang, Dorota G. Pijanowska, Chi-Hang Chin, Cheng-En Lue, **Chao-Sung Lai*** "LAPS with nanoscaled and highly polarized HfO_2 by CF_4 plasma for NH4 detection", Sensors and Actuators B (2013) SCI 3.535

International Invited Talk

1. Invited talk 6th Asian Conference on Electrochemistry, May 11 - 14, 2008.
2. Invited talk The 2nd NSC- Japan Science and Technology Agency, Nano Device Workshop, July 23 to 24, 2009.
3. Invited talk 2010 IEEE International Conference on Electron Devices and Solid-State Circuits (EDSSC'10) December 15, 2010, Hong Kong
4. Invited talk International Conference on Materials for Advanced Technologies 2011, Singapore
5. Invited talk IEEE AICON 2011, China
6. Invited talk ICTAP 2011, India
7. Invited talk VCNST 2011, China
8. Invited talk ACCS 2011, Taipei
9. Invited talk ICMAT 2011, Singapore
10. Invited talk VCNST 2012, China
11. Invited talk IEEE , 2012 EDSSC (International Conference on Electron Devices and Solid-State Circuits) Thailand
12. Invited talk IEEE , 2013 INEC (International NanoElectronics Conference) Singapor.
13. Invited talk IEEE , 2014 INEC (International NanoElectronics Conference) Japan, Sapporo.
14. Keynote Speaker, MRS-J 2015, Japan, Yokohama.
15. Invited talk ACCS , 2015 Malaysia, Penang.
16. Invited talk 228th ECS Meeting , 2015 US, Arizona.

17. Invited talk IEEE DL Talk , 2015 Singapore, SUTD.
18. Invited talk IEEE INEC, 2016 China, Chendu.
19. Invited talk IEEE NANO, 2016 Japan, Sendai.

International Committee：

1. 2009 International Electron Devices and Materials Symposia, Organizing Chair.
2. 2010 IEEE International Conference on Electron Devices and Solid-State Circuits (EDSSC'10), Steering-committee, International Advisory Committee.
3. 2011 IEEE INEC (International NanoElectronics Conference), Organizing Chair.
4. 2011 The Virtual Conference on Nanoscale Science and Technology (VCNST 2011), (Program-committee June03-Jun06)
5. 2012 IEEE International Conference on Electron Devices and Solid-State Circuits (EDSSC'10), Steering-committee, International Advisory Committee.
6. 2012 The Virtual Conference on Nanoscale Science and Technology (Steering-committee June03-Jun06)
7. 2012 International Conference on Solid State Devices and Materials (ssdm 2012), Program committee.
8. 2012 International Conference on Small Science, Steering-committee, 16-19 Dec, Orlando, USA.
9. IEEE, 2013 INEC (International NanoElectronics Conference) Singapore, International Advisory Committee.
10. 2013 International Conference on Solid State Devices and Materials (ssdm 2013), Program committee.
11. International Conference on Solid State Devices and Materials (ssdm 2014), Program committee, Vice Chair.(Japan)
12. International Conference on Solid State Devices and Materials (ssdm 2015), Program committee, Vice Chair. (Japan)
13. International Conference on Solid State Devices and Materials (ssdm 2016), Program committee, Vice Chair. (Japan)

Title: Nitrided and Fluorinated Graphene for the Applications on High Mobility Graphene Transistor, Memory and Chemical Sensor

Professor, Chao Sung LAI
Dean, College of Engineering Institute of Electronic Engineering, Chang Gung University Taiwan Tel:+886-3-2118800 ext 5786, Email : cslai@mail.cgu.edu.tw

Abstract: A novel graphene based insulator, fluorographene, is firstly applied as gate dielectric in a field effect transistor. To identify the dielectric quality, dielectric constant, breakdown electric field and thermal stability are investigated. In this talk, the scalable and one-step fabrication of single atomic-layer transistors is demonstrated by the selective fluorination of graphene using a low-damage CF4 plasma treatment, where the generated F-radicals preferentially fluorinated the graphene at low temperature (<200 °C) while defect formation was suppressed by screening out the effect of ion damage. The fluorographe was also used as decoupling for graphene as its substrate and mobility was improved much.

Graphene nanodiscs (GNDs), functionalized using NH3 plasma, as charge trapping sites (CTSs) for non-volatile memory applications have been investigated. The fabrication process relies on the patterning of Au nanoparticles (Au-NPs), whose thicknesses are tuned to adjust the GND density and size upon etching. A GND density as high as 8×10^{11} cm^{-2} and a diameter of approximately 20 nm are achieved. The functionalization of GNDs by NH3 plasma creates NH^{+} functional groups that act as CTSs, as observed by Raman and Fourier transform infrared spectroscopy. This inherently enhances the density of CTSs in the GNDs, as a result, the charge loss is less than 10% for a 10-year data retention testing, making this low-temperature process suitable for low-cost non-volatile memory applications on flexible substrates. Moreover, the pH, pNa ion sensing properties of graphene based ion-sensor by nickel end contact modification were demonstrated. The pH and pNa sensitivities were around 36.5mV/pH and 15.3mV/pNa, respectively, for pristine graphene. For Ni end-contact modified graphene, sensitivities are changed to 41mV/pH and no pNa sensitivity.

Selected Publications:

[1] Small, 10, No. 5, 989–997(2014).
[2] Scientific Reports 4:5893 (2014).
[3] Advanced Materials 27(41) (2015)
[4] IEEE Electron Device Letters PP(99):1-1 (2016)
[5] IEEE Transactions on Nanotechnology (99):1-1 (2017)

[6] Carbon 113:318e324 (2017)
[7] Scientific Reports 7:44112 (2017).

Short biography: Chao-Sung Lai received the B. S. and Ph.D. degrees from National Chiao Tung University, Hsinchu, Taiwan, in 1991 and 1996 respectively. He then, joined in 1997 Chang Gung University, Taoyuan in Taiwan, and was promoted to Full Professor in 2006. from 2007 to 2013, he had been the Chairman of the Department of Electronic Engineering. From 2012, he is the Dean of Engineering College, Chang Gung University. Since January 2015, Professor C.S Lai serves as a distinguished lecturer for the IEEE Electron Devices Society. He is elected as the board director of the Association of Chemical Sensors in Taiwan from 2016.