CENTER FOR RELIABILITY SCIENCES AND TECHNOLGIES

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Inside this issue (Jan 2022-Dec 2022)

New Students join CReST




Rajarshi Sarkar and Pratik Arya are admitted to the Ph.D. Program of the Department of Electronics engineering. Hawaibam Thoithoi Singh and Nilim Akash Baruah are admitted to the Master Program of the Department of Electronics engineering. They will be supervised by Prof. Cher Ming Tan in CReST for their tenure. Their research areas will be radiation effect on advanced semiconductor devices, Analog IC Design, Digital IC Design, Cadence ADEL and LabView for Reliability Testing automation.

KEYNOTE AND INVITED TALKS

Prof. Tan presents a keynote speech in ICISSI-2022 (International Conference On Intelligent Systems and Smart Infrastructure), May 21-22, 2022, India.

Prof. Tan presents a keynote speech in 2nd Global Summit and Expo on Nanotechnology and Nanomaterials (GSENN-2022), June 13-15, 2022, Copenhagen, Denmark.

Prof. Tan presents his invited talk on Extending Material sciences to Reliability Science for the understanding and prediction of engineering products degradation in 2nd Global Experts Meet on Materials Science & Engineering (GEMMSE-22), June 16-18, 2022, Rome, Italy.

Prof. Tan presents Tutorial in 29th International Symposium on the Physical and Failure Analysis of Integrated Circuits (IPFA 2022), July 18-20, 2022, Singapore.

Prof. Tan presents his invited talk in 29th International Symposium on the Physical and Failure Analysis of Integrated Circuits (IPFA 2022), July 18-20, 2022, Singapore.

Prof. Tan presents his invited talk on Applications of Optical Scanner for Product early degradation in the 30th CADMEN conference, Oct. 19, 2022, Taipei, Taiwan.

Prof. Tan presents his invited talk on 3D Finite element modelling for interconnections in advanced VLSI technology node in 2022 IEEE 16th International Conference on Solid-State and Integrated Circuit Technology (ICSICT 2022), October 25-25, Nanjing, China.

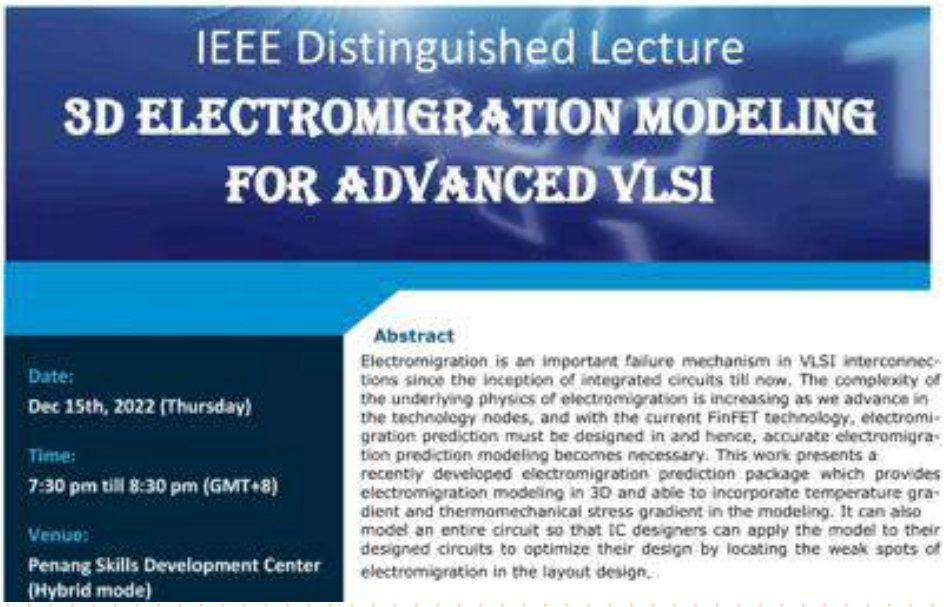
Prof. Tan presents his invited talk on Radiation Effect in Advanced Semiconductor devices in International Conference on Astronautics and Space Exploration (iCASE2022), November 4, 2022, Tainan, Taiwan.

Prof. Tan presents his invited talk on the Reliability Demand for Products and its solutions in 2022 Workshop on Advances in Reliability, November 17, 2022, Academia Sinica, Taiwan.

Prof. Tan presents his invited talk on December 1, 2022 in Department of Physics, National Chung Cheng University, Taiwan.

Prof. Tan presents his invited talk on ” Reliability Demands and Solutions for Current Products and Systems” on December 12, 2022 in Singapore University of Technology and Design.

Prof. Tan presents IEEE Distinguished Lecture on “3D ELECTROMIGRATION MODELING FOR ADVANCED VLSI” in Penang, Malaysia on Dec. 15, 2022.



Prof. Chen presents his invited talk on “Unveiling the reaction mechanism of atomically dispersed Fe electrocatalyst toward urea oxidation reaction” in Taipei International Conference on Catalysis (TICC-2022), Taipei, Taiwan.

Prof. Chen presents his invited talk on “In situ Unveiling the Active Structure of Atomically Dispersed Fe Electrocatalyst in Urea Oxidation Reaction” in 2022 TwIChE, New Taipei City, Taiwan.

2022 TwIChE 淡江大學 12.02-03

台灣化學工程學會69週年年會

暨國科會化學工程學門成果發表會/台、日、韓、捷化學工程國際研討會

感　謝　狀

茲感謝

陳効謙 教授

擔任台灣化學工程學會69週年年會暨

國科會化學工程學門成果發表會/ 台、日、韓、捷化學工程國際研討會

學術論壇 特邀講者

隆情厚誼 特申謝忱

潘文炎 理事長

吳乃立 特聘教授

林正嵐 教授

Visit to Singapore University of Technology and Design and Changi General hospital

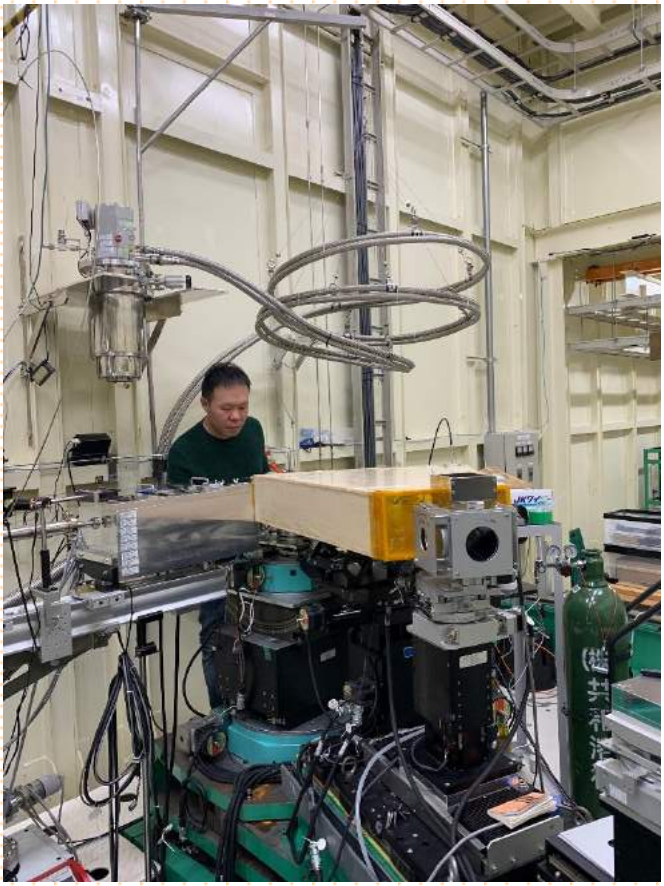
The persons in the photo from left to right are: Prof Lei (Dean of International Affair), Prof Tan, Provost (SUTD), Prof Lai (Dean of Engineering, CGU), Associate Provost (SUTD), Prof Sheu

Prof. Tan, Prof. Chao Sung Lai (Dean of Engineering), Chair Prof. Bing J. Sheu, Prof. Kin-Fong Lei and Prof. I-Chyn Wey visited Singapore University of Technology and Design (SUTD) on Dec. 11-14, 2022. CGU and SUTD will strengthen the research cooperation to each other, and encourage the graduates of the master's program of the school to apply for the doctoral program of two universities. On the other hands, two universities also increase the number of exchanged students and actively explore the plan of dual doctoral degrees from the two universities.

Prof. Tan also visited the Changi General hospital. The CEO of the hospital is standing on the left hand side of Prof. Tan.

Prof. Chen's Research Abroad in Hyogo, Japan

In situ partial fluorescence yield can be used to distinguish the splitting of the 3d-orbital during the reaction. The change of the 3d-orbital can reveal the process of the catalyst under applied voltage for UOR. Especially for the adsorption of the urea, it is hard to observe the different from oxidation state, but the orbital and coordination environment should be examined clearly from PFY and XES.



MOU Signing with SGS and CGMH

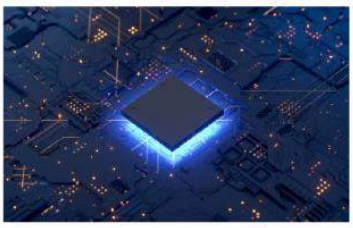
The CReST of Chang Gung University signed an MOU with CGMH and SGS to jointly develop radiation testing and analysis related technologies for Taiwan's semiconductor industry.

External Course

Prof. Tan gave an external course on Automotive Semiconductor Reliability Technology- Calculation of Transient Failure Rate in SGS (Société Générale de Surveillance), Taiwan.

SGS 車用半導體可靠度技術 -暫態失效率計算課程

課程目的



隨著汽車電子蓬勃發展，因應車用電子元件可靠度要求，Soft Error Rate 量化估計方法已逐漸受到重視，而如何在ISO26262功能安全標準中對半導體IC考慮暫態失效(Transient Fault)，對台灣半導體公司也是一巨大挑戰。此訓練課程將使學員了解暫態失效的發生原理，以及如何透過測試設計來精確獲得此數據，最終能透過可靠度設計方法，以提升元件對粒子輻射的強健性。

課程大綱 詳如 Annex 1

- The requirement of soft error in ISO 26262 standard.
- Why radiation is important to electronics and the terrestrial environment
- The Soft Error testing in JEDEC 89B
- The alpha ASER testing introduction
- Total solution of alpha ASER testing provided by SGS
- The neutron and proton of soft error testing introduction
- Radiation effect on semiconductor devices (CMOS and Bipolar devices): TID, DD and SEE
- Critical charge for electronics circuit for radiation interruption and its computation
- Computation of SEE Rate and TID Tolerance
- Standards and References

培訓受益

- 協助學員了解汽車電子對暫態失效原理與測試方法
- 協助學員了解暫態失效與 ISO 26262 關係
- 協助學員了解可靠度設計方法，以提升元件對粒子輻射的強健性。

培育對象

- 汽車電子半導體、硬體、可靠度工程師

講師介紹 詳如 Annex 2

- SGS 功能安全專家 張國樑 技術經理
- SGS 功能安全專家 楊智仁 技術經理
- SGS 輻射防護專家 吳信憲 主任
- 長庚大學可靠度科學技術研究中心 陳始明教授

訓練時程

- **訓練日期：2022/12/5(一)，9:30a.m.~ 4:30p.m.**
- 授課地點：SGS 半導體產業訓練中心：新竹縣竹北市嘉豐十一路一段100號5F-9

A special interview of Professor Tan by Economic Daily News

Link : https://money.udn.com/money/story/5723/6049660

Industry Visits to CReST

Visit of TREND POWER TECHNOLOGY(兆普科技) on March 18, 2022.

Visit of Realtek Semiconductor Corp. (瑞昱半導體) on March 31, 2022.

Visit of EISBG (Energy Infrastructure and Industrial Solutions Business Group；能源基礎設施暨工業解決方案事業群) of Delta Electronics on March 25, 2022.

Visit of PROWAVE (譜威科技) on Aug 5, 2022.

Visit of Hinton Information Services(涵堂資訊) on Sept 6, 2022.

Visit of CTO of Delta Electronics on Nov 25, 2022.

Visit of Director of Reliability, Microsoft USA on Dec 9, 2022.

Awards

Prof. Tan awarded

1. World's Top 2% Scientists (2021 and 2022)

2. Gold Medal for GaN based Circuit design and fabrication in Taiwan Innotech Expo (Oct 2022)

3. Professor Award of Infineon for excellent results of industrial collaborations (2022)

4. **Best Teacher for Industrial Collaboration (技合獎) in Chang Gung University (2022)**
5. **Fellow of International Association of Advanced Materials, Sweden**
6. **Competition of off-campus internship in Department of Electronics, Chang Gung University**

長庚工獎字第 1111017007 號

獎狀

恭喜以下團隊榮獲

111 學年度校外實習課程成果競賽

第二名

所屬單位：電子系

學生姓名：呂珅彤、郭祐成

實習主題：電催化劑製備與應用

指導教師：陳始明老師

合作機構：景鴻科技有限公司

技術教師：王嘉慶 服務部/工程師

特頒此狀 以茲鼓勵

此證

長庚大學

院長 賴朝松

中華民國 111 年 10 月 17 日

監印人：

Researchers Joined in CReST

Dr. Wei-Hao Chiu Joined CReST

Wei-Hao Chiu received his Ph.D. degree in Institute of Electro-Optical Engineering (IEO), National Chiao Tung University (NCTU) in2011. Between 2012 and 2020, he worked at Department of R&D, United Renewable Energy (URE) for new product development of c-Si solar cell and its module as assistant manager. He is currently a associate researcher at CReST, Chang Gung University (CGU). His research mainly focuses on failure mechanisms of Li-battery, high performance perovskite solar cell and its stability issue.

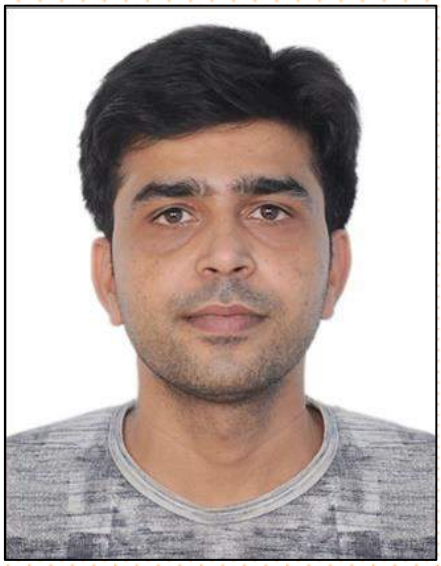
Dr. Duc Dung Nguyen Joined CReST

Duc Dung Nguyen received his Ph.D. in Materials Science & Engineering from National Tsing-Hua University in 2012, before which he graduated from Vietnam National University (Hanoi) in 2004 with a B.S. degree in Physics. Dr. Nguyen's research interest has been focused on the synthesis of biomaterials for ophthalmic applications, manipulation of carbon nanomaterials toward applications in flexible transparent electronics, and development of novel radiation shields (one representative work was inducted as a moonshot project by Google Solve for X in 2016). He has authored and co-authored more than 36 peer-reviewed articles with an average impact factor of 9.7 and over 1680 citations.

Dr. Debesh Mishra Joined CReST

Debesh has received a Ph.D. degree from the Department of Metallurgical and Materials Engineering, IIT Roorkee. He has served as an assistant professor in the Department of Applied Mechanics, MNNIT Allahabad for 2 years. He has also worked as a postdoctoral researcher at Wuhan University of Technology and Hubei university for 4 years together. Recently he is working as a postdoctoral researcher at the CReST, CGU. His main topic of research is mechanical vibration, failure analysis, and reliability of mechanical systems. Apart from this, he has worked and hand in experience in areas like photocatalysis, perovskite solar cells, solar desalination, steel-metal working, powder metallurgy, and plastic deformation (Forging, rolling, isostatic and hot pressing).

Dr. Atul Kumar Dubey Joined CReST



Atul Kumar Dubey received his Ph.D. Degree in 2021 from “Department of Physics, IIT Delhi, India”. The research work of his Ph.D. was related to the light interaction with matter for illumination system in which he developed phosphor-converted sources, sunlight harvesting system and excelled in laser based speckle reduction mechanism. After his Ph.D., he worked in IRD, IIT Delhi as a Project Scientist from March 2021 to May 2022 . His job in this project was to develop a thermally stable diffraction grating for the development of the SBC based high-power fiber laser system for industrial applications. Atul Kumar Dubey joined the CReST Lab on 06 June 2022 as a post-doctoral researcher. Right now, he is working on the reliability of semiconductor devices under radiation effects.

Publications

International Journal

1. **Tan, C. M**., Chen, H. H., Wu, J. P., Sangwan, V., Tsai, K. Y., & Huang, W. C.
   Root Cause Analysis of a Printed Circuit Board (PCB) Failure in a Public Transport Communication System.
   Applied Sciences, 12(2), 640； DOI:10.3390/app12020640
2. Adhikari, Aparna, Arijit Roy, and **Cher Ming Tan**
   Atomic drift-less electromigration model for submicron copper interconnects
3. **Tan, Cher-Ming**
   Editorial for Special Issue on Reliability Analysis of Electrotechnical Devices.
   Applied Sciences 12.8 (2022): 4086 ；DOI:10.3390/app12084086
4. Shabir, Abdul, and **Cher Ming Tan**
   Moisture dependent degradation rate of silicone in LED optical housing material–ab-initio modelling
   IEEE Transactions on Device and Materials Reliability (2022).
5. Shuen-Lin Jeng, **Cher Ming Tan**, Ping-Chia Chen
   Statistical distribution of Lithium-ion batteries useful life and its application for battery pack reliability
   Journal of Energy Storage 51(2022)104399, 2022.03；
   DOI:10.1016/j.est.2022.104399
6. Jiali Wang, Hsiao-Chien Chen, Hui-Ying Tan, **Cher Ming Tan**, Yanping Zhu, and Hao Ming Chen
   Strong Correlation between the Dynamic Chemical State and Product Profile of Carbon Dioxide Electroreduction
   ACS Applied Materials & Interfaces,14,22681-22696
7. Hsu, S.C.; Chiang, H.H.; Huang, T.Y.; Chao, S.H.; Wu, R.T.; Lu, C.Z.; Huang, J.H.; Chang-Jian C.W.*; Weng H.C.*; **Chen H.C.***
   Morphology evolution and electrochemical behavior of NixMn1-x(OH)2 mixed hydroxides as high-performance electrode for supercapacitor.
   Electrochimica Acta, 2022, 403, 139692.
8. Lu, Y.R.1; **Chen, H.C**; Liu, K.; Liu, M.; Chan, T.S.; Hung, S.F.
   Turn the Trash into Treasure: Egg-White-Derived Single-Atom

Electrocatalysts Boost Oxygen Reduction Reaction.
ACS Sustainable Chemistry & Engineering, 2022, 10, 6736

9. Pan, Y.; Ma, X.; Wang, M.; Yang, X.; Liu, S.; **Chen, H.C**.; Zhuang, Z.; Zhang, Y.; Cheong, W.C.; Zhang, C.; Cao, X.; Shen, R.; Xu, Q.; Zhu, W.; Liu, Y.; Wang, X.; Zhang, X.; Yan, W.; Li, J.; Chen, H.M.*; Chen, C.*; Li, Y.
Construction of N, P co-doped carbon frames anchored with Fe single atoms and Fe2P nanoparticles as robust coupling catalyst for electrocatalytic oxygen reduction.
Advanced Materials, 2022, 29, 2203621
10. Huang, Y.P.; Tung, C.W.; Chen, T.L.; Hsu, C.S.; Liao, M.Y.*; **Chen, H.C.***; Chen, H.M.
In situ probing dynamic reconstruction of copper-zinc electrocatalyst for CO2 reduction.
Nanoscale, 2022, 14, 8944
11. Tung, C.W.; Huang, Y.P.; Hsu, C.S.; Chen, T.L.; Chang, C.J.; Chen, H.M.*; **Chen, H.C.***
Tracking the in situ generation of hetero-metal-metal bonds in phosphide electrocatalysts for electrocatalytic hydrogen evolution.
Catalysis Science & Technology, 2022,12, 3234
12. Hsiao, F.H.; Chung, C.C.; Chiang, C.H.; Feng, W.N.; Tzeng, W.Y.; Lin, H.M.; Tu, C.M.; Wu, H.L.; Wang, Y.H.; Woon, W.Y.; Chen, H.C.; **Chen, C.H.**; Lo, C.Y.; Lai, M.H.; Chang, Y.M.; Lu, L.S.; Chang, W.H.; Chen, C.W.*; Luo, C.W.*
Using Exciton/Trion Dynamics to Spatially Monitor the Catalytic Activities of MoS2 during the Hydrogen Evolution Reaction.
ACS Nano, 2022, 16, 4298.
13. Cao, X.; Huang, A.; Liang, C.; **Chen, H.C.**; Han, T.; Lin, R.; Peng, Q.*; Zhuang, Z.; Shen, R.; Chen, H.M.; Yu, Y.; Chen, C.*; Li, Y.*
Engineering Lattice Disorder on a Photocatalyst: Photochromic BiOBr Nanosheets Enhance Activation of Aromatic C–H Bonds via Water Oxidation.
Journal of the American Chemical Society, 2022, 144, 3386.
14. Xu, X.1; Deng, Q.1; **Chen, H.C.**; Humayun, M.; Duan, D.; Zhang, X.; Sun, H.; Ao, X.; Xue, X.; Nikiforov, A.; Huo, K.; Wang, C. Metal-Organic Frameworks Offering Tunable Binary Active Sites toward Highly Efficient

Urea Oxidation Electrolysis. Research, 2022, 2022, 9837109. (Equal contribution)

15. Sun, H.1; Li, L.1; **Chen, H.C.**; Duan, D.; Humayun, M.; Qiu, Y.; Zhang, X.; Ao, X.; Wu, Y.; Pang, Y.; Huo, K.; Wang, C. Highly efficient overall urea electrolysis via single-atomically active centers on layered double hydroxide. Science Bulletin, 67, 1763. (Equal contribution)
16. **Hsuan-Ling Kao***, Li-Chun Chang, Yun-Chen Tsai, Hsien-Chin Chiu, Microwave Gas Sensor Based on Carbon Nanotubes Loaded on Open Loop Ring Resonators
    IEEE Electron Device Letters, vol. 43, no. 10, 2022, pp. 1740-1743.
17. Chun-Bing Chen, **Hsuan-Ling Kao***, Li-Chun Chang, Yi-Chen Lin, Yung-Yu Chen, Wen-Hung Chung, Hsien-Chin Chiu
    Wound-Dressing-Based Antenna Inkjet-Printed Using Nanosilver Ink for Wireless Medical Monitoring
    Micromachines, vol. 13, 2022, pp.1510.
18. Hsiang-Chun Wang, Chia-Hao Liu, Chong-Rong Huang, Min-Hung Shih, Hsien-Chin Chiu, **Hsuan-Ling Kao**, Xinke Liu
    Improved Ion/Ioff Current Ratio and Dynamic Resistance of a p-GaN High-Elecftron-Mobility Transistor Using an Al0.5GaN Etch-Stop Layer
    Materials, vol. 15, Issue 10, 2022, pp. 3503.
19. Chia-Hao Liu, Chong-Rong Huang, Yi-Jie Kang, Hsien-Chin Chiu, **Hsuan-Ling Kao**, Kuo-Hsiung Chu, Hao-Chung Kuo, Chih-Tien Chen, Kuo-Jen Chang
    Optimization of the Field Plate Design of a 1200 V p-GaN Power High-Electron-Mobility Transistor
    Micromachines, vol. 13, 2022, pp.1554.
20. Hsiang-Chun Wang, Chia-Hao Liu, Chong-Rong Huang, Hsien-Chin Chiu, **Hsuan-Ling Kao**, Xinke Liu
    Hole Injection Effect and Dynamic Characteristic Analysis of Normally Off p-GaN HEMT with AlGaN Cap Layer on Low-Resistivity SiC Substrate
    Micromachines, vol. 13, 2022, pp.807
21. YC Tsai, KH Fan, TL Tsai, CC Lee, T Aso, SW Wu, CY Lin, CK Tseng, CR Chen, S Balaji, **TC Chao**
    Proton radiography using discrete range modulation method–A Monte Carlo study

Radiation Physics and Chemistry, 2022, 200, 110276.

22. S Balaji, CC Lee, T Aso, TH Wu, Y Chiang, LDH Oanh, CK Tseng, CR Chen, **TC Chao**
Investigation of the effects of the step size of Geant4 electromagnetic physics on the depth dose simulation of a small field proton beam
Radiation Physics and Chemistry, 2022, 195, 110050.

23. **Wei-Cheng Lin**, Ming-Chiu Chang, Chien-Hung Liao, and Chun-Ting Hsieh
Design of 0.1mV zero-g and 200μg/√Hz capacitance accelerometer with high sensitivity readout circuit with time to digital convertor applied to finger tremor of neurodegenerative disease
International Journal of Circuit Theory and Applications, 21 March, 2022. https://doi.org/10.1002/cta.3275

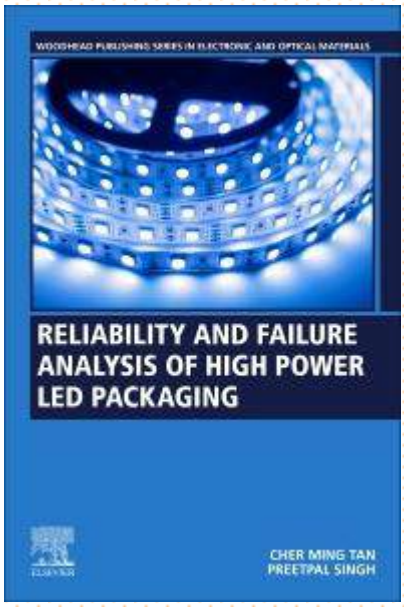
24. **KM Lee**, **WH Chiu**, YH Tsai, CS Wang, YT Tao, YD Lin
High-performance perovskite solar cells based on dopant-free hole-transporting material fabricated by a thermal-assisted blade-coating method with efficiency exceeding 21%
Chemical Engineering Journal 427, 131609

25. D Chandrasekaran, **WH Chiu**, **KM Lee**, JM Liao, HH Chou, YS Yen
Effect of Thiophene Insertion on X-Shaped Anthracene-Based Hole-Transporting Materials in Perovskite Solar Cells
Polymers 14 (8), 1580

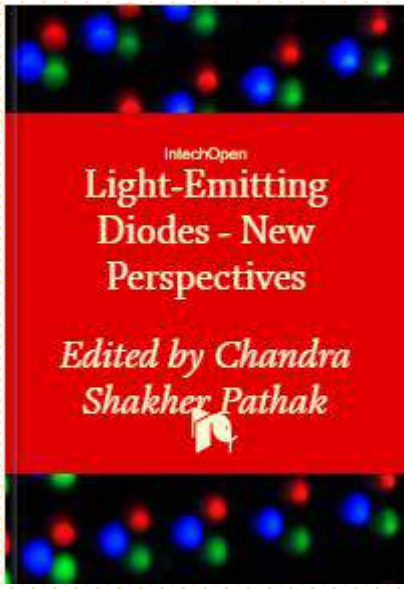
26. **Kun-Mu Lee**, Shun-Hsiang Chan, Chang-Chieh Ting, Shih-Hsuan Chen, **Wei-Hao Chiu**, Vembu Suryanarayanan, Jen-Fu Hsu, Ching-Yuan Liu, Ming-Chung Wu
Surfactant Tween 20 Controlled Perovskite Film Fabricated by Thermal Blade Coating for Efficient Perovskite Solar Cells
Nanomaterials 12 (15), 2651, 2022

Book and Book Chapter

1. Reliability and Failure Analysis of High-Power LED Packaging
   Cher Ming Tan, Preetpal Singh
   Paperback ISBN: 9780128224083
   eBook ISBN: 9780128224076



2. Abdul Shabir and **Cher Ming Tan,** Degradation Analysis of Silicone as Encapsulation and Molding Material in High Power LEDs, book chapter in Light-Emitting Diodes - New Perspectives
   DOI: 10.5772/intechopen.107956



Social Events

Lunch Party

Annual Lab Lunch for staff