

Tilo H. Yang, Ph.D.

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Google Scholar: <https://scholar.google.com/citations?user=2XUaU3YAAAAJ&hl=en>

RESEARCH INTERESTS

- Scanning Transmission Electron Microscope
- Synthesis of Low-dimensional Materials and Nanoelectronic Devices
- Microelectronic Packaging and Heterogeneous Integration
- Solid Thermodynamics, Phase Equilibria, and Phase Diagram

EDUCATION

- **National Taiwan University, Taipei, Taiwan**

Sept. 2014 – June 2019

- Ph.D. in Materials Science and Engineering
- Degree Conferred Date: June 30, 2019
- Dissertation: Development of Materials Hybridization Technology Applied in Lightweight and Smart Materials
- Advisor: Prof. C. Robert Kao
- Co-supervisor: Dr. Akitsu Shigetou (NIMS)

- **National Chung Hsing University, Taichung, Taiwan**

Sept. 2010 – June 2014

- B. Eng. in Materials Science and Engineering
- Project study: Growth of Copper Nanorods Induced by Tensile and Compression Stress
- Advisor: Prof. Shou-Yi Chang

ACADEMIC EXPERIENCE

- **Postdoctoral Associate, Massachusetts Institute of Technology, Cambridge, MA**

Jul. 2023 – Present

- Research topics: Integration of ultrawide bandgap materials with 2D materials and related devices
- Nanomaterials and Electronics Group, Research Laboratory of Electronics (RLE)
- Supervisor: Prof. Jing Kong

- **Postdoctoral Researcher, National Taiwan Normal University, Taipei, Taiwan**

Sept. 2020 – Jun. 2023

- Research Topics:
 1. Tailoring Switchable Ferroelectricity in Rhombohedral-stacked MoS₂ via Growth Process
 - Modulating stacking polytypes in 3R-stacked during growth process to achieve oppositely-polarized 3R domains switching

- Observing atomic structures with scanning transmission electron microscopy
- Demonstrating a 3R-based MoS₂ non-volatile memory prototype and vertical tunneling junction
- 2. Negative Differential Resistance in Monolayer MoS₂ via Defect Engineering
 - Modulating the concentration of sulfur vacancy by direct growth or post-process
 - Estimating the defect concentration via synchrotron radiation-based x-ray photoemission spectroscopy
- 3. Interaction between 2D Materials and Twisted Light with Quantized Orbital Angular Momentum
 - Performing optical characterization (PL spectrum) and electrical characterization (photocurrent) to experimentally verify the influence of twisted light
- Atomic Scale Quantum Nanoelectronics Laboratory, Department of Physics
- Supervisor: Prof. Yann-Wen Lan

● **Visiting Scholar, Waseda University, Tokyo, Japan**

June 2019 – Sept. 2019

- Research Topic: Development of Multifunctional Soft Pneumatic Actuator by Embedding with Ultra-Stretchable Sensors
- Green Innovation Technology Group, Research Organization for Nano & Life Innovation
- Supervisor: Prof. Shuichi Shoji and Prof. Jun Mizuno
- Collaborator: Prof. Jun Shintake from The University of Electro-Communications

● **Junior Researcher, National Institute for Materials Science (NIMS), Tsukuba, Japan**

Sept. 2016 – Aug. 2018

- Research Topic: Development of Solid-State Direct Bonding Technology for Organic and Inorganic Materials
- Surface & Adhesion Science Group
- Supervisor: Dr. Akitsu Shigetou

● **R&D Engineer Intern, Taiwan Semiconductor Manufacturing Company (TSMC), Hsinchu, Taiwan**

Jul. 2015 – Aug. 2015

- Integrated Interconnect and Package Development Division (IIPD)
- Supervisor: Hao-Yi Tsai

● **Teaching Assistant**

- Thermodynamics of Materials, Dept. of Materials Science and Engineering, National Taiwan University, Taipei, Taiwan

Feb. 2019 – June 2019

- Introduction of Materials Science and Engineering, Dept. of Materials Science and Engineering, National Chung Hsing University, Taichung, Taiwan

Sept. 2012 – Jan. 2013

● **Research Assistant**

- Manager of the group-owned SEM (Hitachi-SU3500) and cross-sectional ion-miller (Hitachi-E3500)

Feb. 2015 - Aug. 2016

Teaching and Mentoring

PUBLICATIONS

Journal Papers (¹co-first author; *corresponding author)

- [1] Y. R. Peng, T. Zhang, **T. H. Yang**, S. Y. Tang, S. M. He, P. H. Wang, T. Y. Yang, H. T. Chen, S. S. Huang, Y. C. Chen, H. C. Kuo, J. Kong, Y. L. Chueh, Scalable fabrication of Janus WSSe/WS₂ heterostructures as ultrasensitive detection platform for electrochemical ammonia products by surface-enhanced Raman spectroscopy (SERS), *Chemical Engineering Journal*, 166830, doi: 10.1016/j.cej.2025.166830 (2025).
- [2] B. W. Liang, R. Y. Hsu, W. H. Chang, Y. R. Chen, Y. J. Huang, **T. H. Yang**, Y. L. Li, C. Y. Su, T. H. Lu, Y. W. Lan, Modulation of photoluminescence in a MoS₂ device through tuning the quantum tunneling effect, *Nanoscale Horizons*, doi: 10.1039/d5nh00089k (2025).
- [3] T. Zhang, A. Krayev, **T. H. Yang**, N. Mao, L. Hoang, Z. Wang, H. Liu, Y. R. Peng, Y. Zhu, X. Zheng, E. Isotta, M. E. Kira, A. Rigbi, M. A. Pimenta, Y. L. Chueh, E. Pop, A. J. Mannix, J. Kong, Synthesis-Related Nanoscale Defects in Mo-Based Janus Monolayers Revealed by Cross-Correlated AFM and TERS Imaging, *Small* **21**, 2504742, doi: 10.1002/smll.202504742 (2025).
- [4] X. Zheng, J. Wang, J. Jiang, T. Zhang, J. Zhu, T. Dang, P. Wu, A. Y. Lu, D. R. Chen, **T. H. Yang**, X. Zhang, K. Zhang, K. Y. Ma, Z. Wang, A. Yao, H. Liu, Y. Wan, Y. P. Hsieh, V. Bulović, T. Palacios, J. Kong, Electrostatic-repulsion-based transfer of van der Waals materials, *Nature* **645**, 906-914, doi: 10.1038/s41586-025-09510-0 (2025).
- [5] M. Bogroff, G. Cowley, A. Nicastro, D. Levy, Y. C. Wu, N. Mao, **T. H. Yang**, T. Zhang, J. Kong, R. Vasudevan, K. P. Kelley, B. Lawrie, Non-perturbative cathodoluminescence microscopy of beam-sensitive materials, *Nanophotonics* **14**, 2095-2101, doi: 10.1515/nanoph-2024-0724 (2025).
- [6] D. Hao, W. H. Chang, Y. C. Chang, W. T. Liu, S. Z. Ho, C. H. Lu, **T. H. Yang**, N. Kawakami, Y. C. Chen, M. H. Liu, C. L. Lin, T. -H. Lu, Y. -W. Lan, N. C. Yeh, Magnetic Field-Induced Polar Order in Monolayer Molybdenum Disulfide Transistors, *Advanced Materials*, 2411393, doi: 10.1002/adma.202411393 (2024).
- [7] S. T. Yang, **T. H. Yang^{1*}**; B. W. Liang, H. C. Lo, W. H. Chang, P. Y. Lin, C. Y. Su, Y. W. Lan, Submicron memtransistors made from monocrystalline molybdenum disulfide, *ACS Nano* **18**, 6936–6945, doi: 10.1021/acsnano.3c09030 (2024).
- [8] **T. H. Yang***; B. W. Liang, H. C. Hu, F. X. Chen, S. Z. Ho, W. H. Chang, L. Yang, H. C. Lo, T. H. Kuo, J. H. Chen, P. Y. Lin, K. B. Simbulan, Z. F. Luo, A. C. Chang, Y. H. Kuo, Y. S. Ku, Y. C. Chen, Y. J. Huang, Y. C. Chang, Y. F. Chiang, T. H. Lu, M. H. Lee, K. S. Li, M. Wu, Y. C. Chen, C. L. Lin, Y. W. Lan, Ferroelectric transistors based on shear-transformation-mediated

rhombohedral-stacked molybdenum disulfide, *Nature Electronics* **7**, 29–38, doi:10.1038/s41928-023-01073-0 (2024).

- [9] S. X. Guan, **T. H. Yang**¹, C. H. Yang, C. J. Hong, B. W. Liang, K. B. Simbulan, J. H. Chen, C. J. Su, K. S. Li, Y. L. Zhong, L. J. Li, Y. W. Lan, Monolithic 3D integration of back-end compatible 2D material FET on Si FinFET. *npj 2D Materials and Applications* **7**, doi:10.1038/s41699-023-00371-7 (2023).
- [10] S. Saha, Y. C. Chang, **T. H. Yang**, A. Rice, A. Ghosh, W. You, M. Crawford, T. H. Lu, Y. W. Lan, S. Arafin, Sub-bandgap photoluminescence properties of multilayer h-BN-on-sapphire. *Nanotechnology* **33**, doi:10.1088/1361-6528/ac5283 (2022).
- [11] Y. J. Feng, K. B. Simbulan, **T. H. Yang**, Y. R. Chen, K. S. Li, C. J. Chu, T. H. Lu, Y. W. Lan, Twisted Light-Induced Photocurrent in a Silicon Nanowire Field-Effect Transistor. *ACS Nano* **16**, 9297-9303, doi:10.1021/acsnano.2c01944 (2022).
- [12] W. H. Chang, C. I. Lu, **T. H. Yang**, S. T. Yang, K. B. Simbulan, C. P. Lin, S. H. Hsieh, J. H. Chen, K. S. Li, C. H. Chen, T. H. Hou, T. H. Lu, Y. W. Lan, Defect-engineered room temperature negative differential resistance in monolayer MoS₂ transistors. *Nanoscale Horizons* **7**, 1533-1539, doi:10.1039/d2nh00396a (2022).
- [13] S. T. Yang, **T. H. Yang**¹, C. I. Lu, W. H. Chang, K. B. Simbulan, Y. W. Lan, Room temperature negative differential resistance in clay-graphite paper transistors. *Carbon* **176**, 440-445, doi:10.1016/j.carbon.2021.01.156 (2021).
- [14] **T. H. Yang**^{*}, J. Shintake, R. Kanno, C. R. Kao, J. Mizuno, Low-Cost Sensor-Rich Fluidic Elastomer Actuators Embedded with Paper Electronics. *Advanced Intelligent Systems* **2**, doi:10.1002/aisy.202000025 (2020).
- [15] **T. H. Yang**, H. Hida, D. Ichige, J. Mizuno, C. R. Kao, J. Shintake, Foldable Kirigami Paper Electronics. *Physics status solidi (a)* **217**, doi:10.1002/pssa.201900891 (2020).
- [16] H. Y. Yu, **T. H. Yang**, Y. S. Chiu, C. R. Kao, Surface Diffusion and the Interfacial Reaction in Cu/Sn/Ni Micro-Pillars. *Journal of Electronic Materials* **49**, 88-95, doi:10.1007/s11664-019-07455-5 (2019).
- [17] **T. H. Yang**^{*}, C. R. Kao, A. Shigetou, Organic-Inorganic Solid-State Hybridization with High-Strength and Anti-Hydrolysis Interface. *Scientific Reports* **9**, 504, doi:10.1038/s41598-018-37052-1 (2019).
- [18] **T. H. Yang**, Y. S. Chiu, C. Y. Yang, A. Shigetou, C. R. Kao, Polyimide-polyetheretherketone and tin-polyimide direct bonding via ethanol-assisted vacuum ultraviolet irradiation. *Transactions of The Japan Institute of Electronics Packaging* **12**, E19-012, doi:10.5104/jiepeng.12.E19-012-1 (2019).
- [19] **T. H. Yang**, H. Y. Yu, Y. W. Wang, C. R. Kao, Effects of Aspect Ratio on Microstructural Evolution of Ni/Sn/Ni Microjoints. *Journal of Electronic Materials* **48**, 9-16, doi:10.1007/s11664-018-6587-9 (2018).
- [20] J. J. Yu, J. Y. Wu, L. J. Yu, **H. W. Yang**, C. R. Kao, Micromechanical behavior of single-crystalline

Cu₆Sn₅ by picoindentation. *Journal of Materials Science* **52**, 7166-7174, doi:10.1007/s10853-017-0952-6 (2017).

- [21] **H. W. Yang**, J. Y. Wu, Z. X. Zhu, C. R. Kao, Effects of surface diffusion and reaction-induced volume shrinkage on morphological evolutions of micro joints. *Materials Chemistry and Physics* **191**, 13-19, doi:10.1016/j.matchemphys.2017.01.022 (2017).
- [22] **H. W. Yang***, C. R. Kao, A. Shigetou, Fast Atom Beam- and Vacuum-Ultraviolet-Activated Sites for Low-Temperature Hybrid Integration. *Langmuir* **33**, 8413-8419, doi:10.1021/acs.langmuir.7b02010 (2017).

Conference Proceedings

- [1] J. Zhu, A. Yao, P. Wu, Y. Jiao, J. H. Park, J. Jiang, **T. H. Yang**, A. S. Gupta, S. S. Cheema, J. Kong, T. Palacios, "Enhancement-Mode Multichannel MoS₂ Transistor with Spacer Engineering and Design-Technology Co-Optimization Based on the 8" Platform", The 70th International Electron Devices Meeting (IEDM), 2024.
- [2] **T. H. Yang**, Y. S. Chiu, H. Y. Yu, C. R. Kao, A. Shigetou, "A Single Bonding Process to Achieve Various Organic-Inorganic Substrate Integration in IoT", The 69th Electronic Components and Technology Conference (ECTC), 2019.
- [3] **T. H. Yang**, C. Y. Yang, A. Shigetou, C. R. Kao, "A Single Process for Homogeneous and Heterogeneous Bonding in Flexible Electronics", International Conference on Electronics Packaging (ICEP), 2019.
- [4] **T. H. Yang**, C. R. Kao, A. Shigetou, "Organic/Inorganic Interfacial Microstructures Achieved by Fast Atom Beam Bombardment and Vacuum Ultraviolet Irradiation", International Conference on Electronics Packaging (ICEP), 2018.
- [5] **T. H. Yang**, H. Y. Yu, and C. R. Kao, "Critical Factors Affecting Structural Transformations in 3D IC Micro Joints", The 67th Electronic Components and Technology Conference (ECTC), 2017.
- [6] **T. H. Yang**, C. R. Kao, "Morphological Evolution Induced by Volume Shrinkage in Micro Joints", International Conference on Electronics Packaging (ICEP), 2016.
- [7] C. C. Li*, S. J. Hsu, C. C. Lee, L. L. Liao, M. J. Dai, C. K. Liu, Z. X. Zhu, **T. H. Yang**, J. H. Ke, C. Robert Kao, and G. J. Snyder, "Development of Interconnection Materials for Bi₂Te₃ and PbTe Thermoelectric Module by using SLID Technique", The 65th Electronic Components and Technology Conference (ECTC), 2015.

Patents

- [1] Akitsu Shigetou and **Hong Wei Yang**, "Method for manufacturing layered article, layered article, and heated toilet seat device", WIPO (PCT) Patent, Patent No: WO2019221288A1, Published on Nov. 21, 2019.
- [2] Akitsu Shigetou and **Hong Wei Yang**, "Method for manufacturing layered article, layered article, and heated toilet seat device", Japan Patent, Patent No: JP7018223B2, Published on Feb. 10, 2022.
- [3] Akitsu Shigetou and **Hong Wei Yang**, "Method for manufacturing layered article, layered article, and heated toilet seat device", China Patent, Patent No: CN112105502B, Published on Dec. 2,

2022.

- [4] Akitsu Shigetou and **Hong Wei Yang**, "Method for manufacturing layered article, layered article, and heated toilet seat device", European Patent, Patent No: EP3795356B1, Published on Jul. 26, 2023.

CONFERENCE PRESENTATIONS

- **Poster**, "Sliding ferroelectric memory based on rhombohedral-stacked molybdenum disulfide" In Session: S7 - Nanoscience & Nanotechnology, Microsystems Annual Research Conference (MARC) 2025, Boston, MA, Jan. 14-15, 2025.
- **Poster**, "Atomically-thin ferroelectric transistors made from rhombohedral-stacked MoS₂" In Session: S6 - Nanotechnology & Nanomaterials, Microsystems Annual Research Conference (MARC) 2024, Boston, MA, Jan. 23-24, 2024.
- **Poster**, "A BEOL-Compatible Process for Monolithic 3D Integration of MoS₂ FET and Si FinFET" In Session: O4-Surface and Low Dimensional Physics, Taiwan Physics Society Annual Meeting 2023, Taipei, Taiwan, Jan. 24-26, 2023.
- **Oral**, "A BEOL-Compatible Process for Monolithic 3D Integration of MoS₂ FET and Si FinFET", The 13th Recent Progress in Graphene and Two-dimensional Materials Research Conference (RPGR), Taipei, Taiwan, Nov. 13-17, 2022.
- **Oral**, "Threefold Symmetrical Growth of MoS₂ Homoepitaxy with Enhanced Valley Polarization" In Session: O4-Surface and Low Dimensional Physics, Taiwan Physics Society Annual Meeting 2022, Taipei, Taiwan, Jan. 24-26, 2022.
- **Oral**, "A Single Bonding Process to Achieve Various Organic-Inorganic Substrate Integration in IoT" In Session: Bonding Manufacturing Technologies, ECTC 2019, Las Vegas, NV, May 25-Jun. 2, 2019.
- **Oral**, "A Single Process for Homogeneous and Heterogeneous bonding in Flexible Electronics", International Conference on Electronics Packaging (ICEP), ICEP 2019, Toki Messe, Niigata, Japan, Apr. 17-20, 2019.
- **Poster**, "Technology of Material Hybridization Applied in Micro-Assembly of Flexible Electronics for Human-Machine Interface", 4th Osaka University-Joining and Welding Research Institute (JWRI)/National Taiwan University (NTU)-Dpt. of Materials Science and Engineering (MSE) Workshop, Taipei, Taiwan, Mar. 7, 2019.
- **Oral**, "Technology of Material Hybridization Applied in Micro-Assembly of Flexible Electronics for Human-Machine Interface", The 3rd Japan-Taiwan International Engineering Forum, Tokyo Institute of Technology (TIT), Tokyo, Japan, Feb. 27-Mar. 1, 2019.
- **Oral**, "Organic-Inorganic Hybrid Bonding Applied in Lightweight and Smart Structural Materials", Asia-Oceania Top University League on Engineering (AOTULE) Postgraduate Student Conference 2018, Indian Institute of Technology (IIT) Madras, Madras, India, Nov. 21-23, 2018.
- **Oral**, "Organic/Inorganic Interfacial Microstructures Achieved by Fast Atom Beam Bombardment and Vacuum Ultraviolet Irradiation", International Conference on Electronics Packaging (ICEP),

ICEP 2018, Kuwana, Mie, Japan, Apr. 17-21, 2018.

- **Oral**, “Fast Atom Beam- and Vacuum-Ultraviolet-Activated Sites for Low-Temperature Hybrid Integration”, NTU-NIMS workshop, Kaohsiung, Taiwan, Dec. 18, 2017.
- **Oral**, “Fast Atom Beam- and Vacuum-Ultraviolet-Activated Sites for Low-Temperature Hybrid Integration”, Taiwan-Japan Workshop on Electronic Interconnection I, Taipei, Taiwan, Oct. 24, 2017.
- **Oral**, “Critical Factors Affecting Structural Transformations in 3D IC Micro Joints” In Session: 3D Cu-Cu and Micro Bump Bonding Technologies, ECTC 2017, Orlando, FL, May 30-Jun. 2, 2017.
- **Oral**, “Morphological Evolution Induced by Volume Shrinkage in Micro Joints”, International Conference on Electronics Packaging (ICEP), ICEP 2016, Sapporo, Hokkaido, Japan, Apr. 20-22, 2016.

Honors, Awards, and Scholarship

- Intel Best Student Paper Award: 2019 69th Electronic Components and Technology Conference (ECTC) (2019).
- Visiting Scholarship sponsored by Japan-Taiwan Exchange Association (2019).
- Honorary Member of The Phi-Tau-Phi Scholastic Honor Society (2019).
- 2019 TSIA PhD Student Award sponsored by Taiwan Semiconductor Industry Association (TSIA) (2019).
- EPS ECTC Student Travel Award: 2019 69th Electronic Components and Technology Conference (ECTC) (2019).
- Annual Outstanding University Youth of National Taiwan University (2018).
- Student Representative of College of Engineering at the Asia-Oceania Top University League on Engineering (AOTULE) Conference (2018).
- Best Oral Presentation Award: 2017 1st Taiwan-Japan Workshop on Electronic Interconnection I (2017).
- International Joint Graduate School (IJGS) Scholarship sponsored by National Institute for Materials Science (NIMS), Japan (2016-2018)
- IEEE CPMT Japan Chapter Young Award: 2016 International Conference on Electronics Packaging (ICEP) (2016).
- Scholarship of Direct PhD Program sponsored by National Taiwan University (2015-2018).
- Youth Representative of Taiwan in the Program: 2013 Japan-East Asia Network of Exchange for Students and Youths (2013).

SERVICES

- **Research grants**
 - “Non-volatile memory based on interfacial ferroelectricity in 3R-stacked MoS₂”, grant number: 112-2917-I-564-010. Sponsor: National Science and Technology Council (NSTC) Taiwan.
- **REVIEWER ACTIVITIES**
 - Materialia

- Nature Communications
- Advanced Materials

Technical Expertise and Certification

1. E-beam Lithography
2. Chip Manufacturing Process
3. Device Pattern Design (AutoCAD and Fusion 360)
4. Electronic Characterizations of 2D Materials Transistor and Memory
5. Raman and Photoluminescence Spectroscopy
6. Field-Emission Electron Probe Microanalysis (JEOL JXA-8500F)
7. Field-Emission Scanning Electron Microscopy (NOVA NANO SEM 450)
8. Field-Emission Transmission Electron Microscopy (Tecnai G2 F30)
9. Focus Ion Beam System (JIB-4000)
10. Auger Electron Spectroscopy (JEOL JAMP 9510F)
11. Ion milling (Hitachi-E3500)
12. Surface profile measurement: Optics-Type (BMT WLILAB), Probe-Type (DekTak 6M)
13. Atomic Force Microscope (SII Nanotechnology-L-trace)
14. Micro Raman Spectrometer (Horiba-Jovin Yvon T64000)
15. Fourier Transform Infrared Spectroscopy (Thermo Scientific Nicolet 4700)
16. X-ray Photoelectron Spectroscopy (Ulvac-Phi)
17. X-ray Diffractometer (Rigaku SmartLab)
18. Electroplating and Electroless Plating
19. Chip Alignment and Die Bonder

Language Certification

- English: TOEFL (Score: 97/120)
- Japanese: Japanese Language Proficiency Test (Level 1, the top level)

REFERENCES

- Professor C. Robert Kao (Ph.D. advisor)
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- Professor Jun Mizuno (Ph.D. co-advisor)
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