Curriculum Vitae

Yit-Tsong Chen (陳逸聰)

Current Position

Professor and Chair
Department of Chemistry
National Taiwan University

Adjunct Research Fellow, Institute of Atomic and Molecular Sciences
Academia Sinica

Education

National Taiwan University, B. S. of Chemistry, September 1976–June 1980

University of Chicago, Ph. D. of Chemistry, September 1983–December 1988
Thesis: "Ultrahigh resolution infrared saturation spectroscopy of fundamental molecules"

Position and Experience

Massachusetts Institute of Technology
Post-doctoral Research Associate, January 1989–March 1991

Department of Chemistry, National Taiwan University
Teaching Assistant, August 1982–July 1983
Associate Professor, August 1991–July 1997
Professor, August 1997–Present

Institute of Atomic and Molecular Sciences, Academia Sinica
Adjunct Assistant Research Fellow, May 1992–June 1994
Adjunct Associate Research Fellow, July 1994–July 2001
Adjunct Research Fellow, August 2001– Present

Fields of Research Interest

1. **Nanotechnology and Biosensors:** applying nanoscale field-effect transistors as a biosensor to study protein-protein interaction, extracellular ionic fluctuation, cellular exo-endocytosis, and neuron-neuron interaction.

2. **Nanomaterials and Nanodevices:** catalytic synthesis and architectural design of morphology, structure, and composition of one- and two-dimensional nanomaterials on multiple functional devices for optoelectronic, energy conversion/storage, and biosensing applications.

3. **Molecular Spectroscopy and Nonlinear Optics:** applying high-resolution molecular spectroscopy with nonlinear laser optics to study the superfine structures,

vibrational dynamics, and Rydberg states of fundamental molecules.

Honors and Awards

College of Science Excellent Teaching Award, NTU, 2000.
National Taiwan University Excellent Teaching Award, 2000.

College of Science Outstanding Teaching Award, NTU, 2001.
National Taiwan University Outstanding Teaching Award, 2001.

Visiting Scholarship, Harvard University, June–August, 2005

Peer Reviewed Publications (since 2010)

1. "Label-free detection of protein-protein interactions using a calmodulin-modified nanowire transistor"
   T.-W. Lin, P.-J. Hsieh, C.-L. Lin, Y.-Y. Fang, J.-X. Yang, C.-C. Tsai, P.-L. Chiang, C.-Y. Pan*, and Y.-T. Chen*
   Proceedings of the National Academy of Sciences U. S. A., **107**, 1047–1052 (2010).

2. "Enhancement of the energy photoconversion efficiency through crystallographic etching of a c-plane GaN thin film"
   A. M. Basilio, Y.-K. Hsu, W.-S. Tu, C.-H. Yen, G.-M. Hsu, O. Chyan, Y. Chyan, J.-S. Hwang, Y.-T. Chen, L.-C. Chen*, and K.-H. Chen*
   Journal of Materials Chemistry, **20**, 8118–8125 (2010).

3. "Electrochemical characterization of InN thin films for biosensing applications"
   A. M. Basilio, Y.-K. Hsu, C. C. Chang, P. C. Wei, A. Ganguly, H. C. Shih, Y.-T. Chen, L.-C. Chen, and K.-H. Chen*
   Journal of New Materials for Electrochemical Systems, **13**, 337–343 (2010).

4. "Photoinduced electron transfer in dye-sensitized SnO_2 nanowire field-effect transistors"
   H.-C. Wu, Y.-C. Huang, I-K. Ding, C.-C. Chen, Y.-H. Yang, C.-C. Tsai, C.-D. Chen*, and Y.-T. Chen*
   Advanced Functional Materials, **21**, 474–479 (2011).

5. "Surface potential variations on a silicon nanowire transistor in biomolecular modification and detection"
   C.-C. Tsai, P.-L. Chiang, C.-J. Sun, T.-W. Lin, M.-H. Tsai, Y.-C. Chang*, and Y.-T. Chen*
   Nanotechnology, **22**, 135503 (2011).

6. "High-quality graphene *p-n* junction via resist-free fabrication and solution-based non-covalent functionalization"
   H.-C. Cheng, R.-J. Shiue, C.-C. Tsai, W.-H. Wang*, and Y.-T. Chen*
   ACS Nano, **5**, 2051–2059 (2011).

7. "Silicon nanowire field-effect transistor-based biosensors for biomedical diagnosis and cellular recording investigation"
   K.-I. Chen, B.-R. Li, and Y.-T. Chen*
   Nano Today, **6**, 131–154 (2011).

8. "Structural, optical and luminescence studies of ZnSe nanowires"
R. Venugopal, R. P. Vijayalakshmi, G. Murali, D. A. Reddy, and Y.-T. Chen
International Journal of Materials Research, **102**, 1503–1506 (2011).

9. "Monitoring extracellular K^+ flux with a valinomycin-coated silicon nanowire field-effect transistor"
K.-S. Chang, C.-J. Sun, P.-L. Chiang, A.-C. Chou, M.-C. Lin, C. Liang, H.-H. Hung, Y.-H. Yeh, C.-D. Chen, C.-Y. Pan*, and Y.-T. Chen*
Biosensors and Bioelectronics, **31**, 137–143 (2012).

10. "Patterned growth of nanocrystalline silicon thin films through magnesiothermic reduction of soda lime glass"
D. P. Wong, H.-T. Lien, Y.-T. Chen, K.-H. Chen*, and L.-C. Chen*
Green Chemistry, **14**, 896–900 (2012).

11. "Changes in plasma membrane surface potentials of PC12 cells as measured by Kelvin probe force microscopy"
C.-C. Tsai, H.-H. Hung, C.-P. Liu, Y.-T. Chen*, and C.-Y. Pan*
PLoS ONE, **7**, e33849 (2012).

12. "Nanowire transistor-based ultrasensitive virus detection with reversible surface functionalization"
P.-L. Chiang, T.-C. Chou, T.-H. Wu, C.-C. Li, C.-D. Liao, J.-Y. Lin, M.-S. Tsai, C.-C. Tsai, C.-J. Sun, C.-H. Wang, J.-M. Fang*, and Y.-T. Chen*
Chemistry – An Asian Journal, **7**, 2073–2079 (2012).

13. "Improved silicon nanowire field-effect transistors for fast protein-protein interaction screening"
T.-Y. Lin, B.-R. Li, S.-T. Tsai, C.-W. Chen, C.-H. Chen, Y.-T. Chen*, and C.-Y. Pan*
Lab on a Chip, **13**, 676–684 (2013).

14. "Biomolecular recognition with a sensitivity-enhanced nanowire transistor biosensor"
B.-R. Li, C.-W. Chen, W.-L. Yang, T.-Y. Lin, C.-Y. Pan, and Y.-T. Chen*
Biosensors and Bioelectronics, **45**, 252–259 (2013).

15. "Improving nanowire sensing capability by electrical field alignment of surface probing molecules"
C.-J. Chu, C.-S. Yeh, C.-K. Liao, L.-C. Tsai*, C.-M. Huang, H.-Y. Lin*, J.-J. Shyue, Y.-T. Chen, and C.-D. Chen*
Nano Letters, **13**, 2564–2569 (2013).

16. "Biologically inspired graphene-chlorophyll phototransistors with high gain"
S.-Y. Chen, Y.-Y. Lu, F.-Y. Shih, P.-H. Ho, Y.-F. Chen, C.-W. Chen, Y.-T. Chen, and W-H. Wang*
Carbon, **63**, 23–29 (2013).

17. "A stable silicon/graphene composite using solvent exchange method as anode material for lithium ion battery"
D. Wong, H.-P. Tseng, Y.-T. Chen, B.-J. Hwang, L.-C. Chen*, and K.-H. Chen*
Carbon, **63**, 397–403 (2013).

18. "Chemical vapor deposition synthesis and Raman spectroscopic characterization of

large-area graphene sheets"
C.-D. Liao, Y.-Y. Lu, S. R. Tamalampudi, H.-C. Cheng, and Y.-T. Chen*
Journal of Physical Chemistry A, **117**, 9454–9461 (2013).

19. "An ultrasensitive nanowire-transistor biosensor for detecting dopamine release from living PC12 cells under hypoxic stimulation"
B.-R. Li, Y.-J. Hsieh, Y.-X. Chen, Y.-T. Chung, C.-Y. Pan, and Y.-T. Chen*
Journal of the American Chemical Society, **135**, 16034–16037 (2013).

20. "Photoelectrochemical activity on Ga-polar and N-polar GaN surfaces for energy conversion"
Y.-G. Lin, Y.-K. Hsu, A. M. Basilio, Y.-T. Chen, K.-H. Chen, and L.-C. Chen*
Optics Express, **22**, A21–A27 (2014).

21. "Advances in nanowire transistors for biological analysis and cellular investigation"
B.-R. Li, C.-C. Chen, U. R. Kumar, and Y.-T. Chen*
Analyst, **139**, 1589–1608 (2014).

22. "High performance and bendable few-layered InSe photodetectors with broad spectral response"
S. R. Tamalampudi, Y.-Y. Lu, U. R. Kumar, R. Sankar, C.-D. Liao, K. M. Boopathi, C.-H. Cheng, F. C. Chou, and Y.-T. Chen*
Nano Letters, **14**, 2800–2806 (2014).

23. "Wide-field imaging and flow cytometric analysis of cancer cells in blood by fluorescent nanodiamond labeling and time gating"
Y.-Y. Hui, L.-J. Su, O. Y. Chen, Y.-T. Chen, T.-M. Liu, and H.-C. Chang*
Scientific Reports, **4**, 5574 (2014).

24. "Binder-free rice husk-based silicon-graphene composite as energy efficient Li-ion battery anodes"
D. Wong, S. Rangaraj, Y. Rathinam, R. Venkatachalam, Y.-T. Chen, B.-J. Hwang L.-C. Chen*, and K.-H. Chen*
Journal of Materials Chemistry A, **2**, 13437–13441 (2014).

25. "Intrinsic electron mobility exceeding 10^3 cm^2/Vs in multilayer InSe FETs"
S. Sucharitakul, N. J. Goble, U. R. Kumar, R. Sankar, Z. Bogorad, F. C. Chou, Y.-T. Chen, and X. P. A. Gao*
Nano Letters, **10**, 3815–3819 (2015).

26. "Tracking and finding slow-proliferating/quiescent cancer stem cells with fluorescent nanodiamonds"
H.-H. Lin, H.-W. Lee, R.-J. Lin, C.-W. Huang, Y.-C. Liao, Y.-T. Chen, J.-M. Fang, T.-C. Lee, A. L. Yu,* and H.-C. Chang*
Small, **11**, 4394–4402 (2015).

27. "Growth of large-area graphene single crystals in confined reaction space with diffusion-driven chemical vapor deposition"
C.-C. Chen,* C.-J. Kuo, C.-D. Liao, C.-F. Chang, C.-A. Tseng, C.-R. Liu, and Y.-T. Chen*
Chemistry of Materials, **27**, 6249–6258 (2015).

28. "Three-dimensional heterostructures of MoS_2 nanosheets on conducting MoO_2 as an efficient electrocatalyst to enhance hydrogen evolution reaction"

R. D. Nikam, A.-Y. Lu, P. A. Sonawane, U. R. Kumar, K. Yadav, L.-J. Li,* and Y.-T. Chen*
ACS Applied Materials & Interfaces, **7**, 23328–23335 (2015).

29. "Isolation and identification of post-transcriptional gene silencing-related small RNAs by functionalized nanowire transistor detection"
K.-I Chen, C.-Y. Pan, K.-H. Li, Y.-C. Huang, C.-W. Lu, C.-Y. Tang, Y. Su, L.-W. Tseng, K.-C. Tseng, C.-Y. Lin, C.-D. Chen, S.-S. Lin*, and Y.-T. Chen*
Scientific Reports, **5**, 17375 (2015).

30. "High photosensitivity and broad spectral response of multi-layered germanium sulfide transistors"
U. R. Kumar, Y.-Y. Lu, C.-J. Kuo, S. R. Tamalampudi, R. Sankar, K. M. Boopathi, A. Anand, K. Yadav, R. J. Mathew, F. C. Chou, and Y.-T. Chen*
Nanoscale, **8**, 2284–2292 (2016).

31. "Ultra-thin layered ternary single crystals $Sn(S_xSe_{1-x})_2$ with bandgap engineering for high performance photo-transistors on rigid and flexible substrates"
P.Perumal, R. K. Ulaganathan, R. Sankar, G. Haider, T.-M. Sun, Y.-M. Liao, M.-W. Chu, F. C. Chou, Y.-T. Chen, M.-H. Shih and Y.-F. Chen*
Advanced Functional Materials, **26**, 3630–3638 (2016).

32. "Acidity-activity correlation over bimetallic iron-based ZSM-5 catalysts during selective catalytic reduction of NO by NH_3"
S. H. Begum, C.-T. Hung, Y.-T. Chen, S.-J. Huang, P.-H. Wu, X. Han, and S.-B. Liu*
Journal of Molecular Catalysis A: Chemical, **423**, 423–432 (2016).

33. "Differential releases of dopamine and neuropeptide Y from histamine-stimulated PC12 cells detected by an aptamer-modified nanowire transistor"
S. Banerjee, Y.-J. Hsieh, C.-R. Liu, N.-H. Yeh, Y.-S. Lai, H.-H. Hung, Y.-T. Chen*, and C.-Y. Pan*
Small, **12**, 5524–5529 (2016).

34. "Screening limited switching performance of multilayer 2D semiconductor FETs the case for SnS"
S. Sucharitakul, U. R. Kumar, R. Sankar, F.-C. Chou, Y.-T. Chen, C. Wang, C. He, R. He, and X. P. A. Gao*
Nanoscale, **8**, 19050–19057 (2016).

35. "Detection of K^+ efflux from stimulated cortical neurons by an aptamer-modified silicon nanowire field-effect transistor"
A. Anand, C.-R. Liu, A.-C. Chou, W.-H. Hsu, U. R. Kumar, Y.-C. Lin, C.-A. Dai, F.-G. Tseng, C.-Y. Pan*, and Y.-T. Chen*
ACS Sensors, **2**, 69–79 (2017)

36. "Epitaxial growth of vertically stacked p-MoS_2/n-MoS_2 heterostructures by chemical vapor deposition for light emitting devices"
R. D. Nikam, P. A. Sonawane, R. Sankar, and Y.-T. Chen*
Nano Energy, **2**, 454–462 (2017)

37. "Fluorescent nanodiamonds enable quantitative tracking of human mesenchymal stem cells in pigs"

L.-J. Su, M.-S. Wu, Y. Y. Hui, B.-M. Chang, L. Pan, P.-C. Hsu, C.-K. Huang, Y.-T. Chen, H.-N. Ho, T.-Y. Ling*, H.-H. Hsu*, and H.-C. Chang*
Scientific Reports, **7**, 45607 (2017)

38. "Detection of electrically neutral and nonpolar molecules in ionic solutions using silicon nanowires"
Y.-P. Wu, C.-J. Chu, L.-C. Tsai, Y.-W. Su, P.-H. Chen, M. K. Moodley, D. Huang, Y.-T. Chen, Y.-J. Yang, and C.-D. Chen*
Nanotechnology, **28**, 165501 (2017)

39. "Targeted and efficient activation of channelrhodopsins expressed in living cells via specifically-bound upconversion nanoparticles"
K. Yadav, A.-C. Chou, U. R. Kumar, H.-D. Gao, H.-M. Lee*, C.-Y. Pan*, and Y.-T. Chen*
Nanoscale, **9**, 9457–9466 (2017).

40. "One-step synthesis of anti-oxidative graphene-wrapped copper nanoparticles on flexible substrates for electronic and electro-catalytic applications"
C.-A. Tseng, C.-C. Chen, U. R. Kumar, C.-P. Lee, H.-C. Chiang, C.-F. Chang, and Y.-T. Chen*
ACS Applied Materials & Interfaces, (DOI: 10.1021/acsami.7b06490) (2017).

Other Academic Publications (since 2010)

1. "奈米線場效電晶體生物感測器" (invited article)
邱慧珊、陳逸聰*
化學，**68**卷**1**期，47–58 (2010).

2. "利用鈣調素修飾之奈米線場效電晶體以無標記地偵測蛋白質間交互作用"
林宗吾、謝博任、林志隆、方怡雅、楊佳勳、蔡佳璋、江佩玲、潘建源、陳逸聰*
中央研究院重要研究成果，**99**，24–25 (2010).

3. "Nanowire field-effect transistors and their applications to cardiology" (invited article)
C.-C. Tsai, C. R. Martin, Y.-. Liu, C.-Y. Pan*, and Y.-T. Chen*
in *Nanomedicine & Cardiovascular System*; R. J. Hunter and V. R. Preedy, Eds.; Science Publishers: New Hampshire, 2011; Chapter 3, pp 45–57.

4. "石墨烯於電晶體的發展與應用" (invited article)
盧怡穎、鄭弘杰、廖均達、陳逸聰*
物理雙月刊，**33**卷**2**期，171–177 (2011).

5. "無標記奈米級生物感測器" (invited article)
楊婉鈴、李博仁、陳逸聰*
化學，**69**卷**3**期，199–209 (2011).

6. "Nanowire field-effect transistor-based biosensors as a tool for life science"
Y.-T. Chen*
ECS Transactions, **64**, 23–32 (2014).

7. "Device Architecture and Biosensing Applications for Attractive One- and Two-Dimensional Nanostructures" (invited article)
C.-D. Liao, T.-C. Tsai, Y.-Y. Lu, and Y.-T. Chen*
in *Nanobiosensors and Nanobioanalyses*; Eiichi Tamiya, Kagan Kerman, Mun'delanji C. Vestergaard, and I-Ming Hsing, Eds.; Springer Publisher (ISBN 978-4-431-55190-4), 2015; Chapter 3, pp 41–70.

Patents

US patent: US 8,420,328 B2
Title of invention: Reusable Nanowire Field-Effect Transistor System for Detecting Biomolecular Interactions
Inventors: Y.-T. Chen, C.-Y. Pan, and T.-W. Lin
Issue date: 2013/4/16
Abstract: A reusable nanowire field-effect transistor for detecting biomolecular interactions. The field-effect transistor contains nanowire covalently linked to a docking molecule, which is capable of binding to an anchor molecule in a reversible manner, i.e., at an association constant of 10^5–10^9 M^{-1}.

International Conference Committee

Asian Spectroscopy Conference, international steering committee member (2007–2015).

Invited Speeches in International Conferences (since 2010)

1. **Invited speech:** "Detecting cellular excitability and protein-protein interactions with nanotube/nanowire transistors", 2011/11/14–17, *9th Asian Conference on Chemical Sensors (ACCS 2011) –Chemical Sensors for Smart Life*, Chientan Youth Activity Center, Taipei, Taiwan

2. **Invited speech:** "Microspectroscopic characterizations of crystalline structure, exciton-phonon excitation, and electron transfer in nanomaterials", 2011/11/28–12/1, *3rd Asian Spectroscopy Conference*, Xiamen University, Xiamen, China

3. **Invited speech:** "Nanowire transistor-based biosensors: A tool for life science", 2013/2/27–3/1, *Indo-US International Workshop on Nanosensor Science & Technology, IWNST-2013*, National Institute of Science & Technology, Palur Hills, Berhampur, Odisha-761008, India

4. **Invited speech:** "Nanowire transistor-based biosensors: A tool for life science", 2013/6/9–10, *UT-SNU-NTU Chemistry Department Joint Symposium 2013,* Seoul National University, Seoul, Korea

5. **Keynote speech:** "Nanowire field-effect transistor-based biosensors: A tool for life science", 2014/8/27–29, *The 3rd International Symposium of Materials on Regenerative Medicine, 2014 ISOMRM*, Chang Gung University, Tao-Yuan, Taiwan

6. **Invited speech:** "Nanowire transistor-based biosensors: A tool for life science", 2014/9/1–2, *The 2nd Kyoto University & National Taiwan University Symposium*,

Kyoto University, Kyoto, Japan

7. **Invited speech:** "Nanowire field-effect transistor-based biosensors as a tool for life science", 2014/10/5–10, *226th Meeting of the Electrochemical Society (ECS)*, Moon Palace Resort, Cancun, Mexico

8. **Invited speech:** "Nanowire transistor-based biosensors: A tool for life science", 2014/11/16–20, *Academia Sinica & University of Hyderabad Symposium*, University of Hyderabad, Telangana, India

9. **Invited speech:** "High photoresponsive nanomembranes-based devices in photodetection and solar-energy conversion applications", 2015/2/8–11, *The 2015 Symposium for the Promotion of Applied Research Collaboration in Asia*, The Golden Academy Conference Series of Asia Pacific Society for Materials Research (APSMR), Sunworld Dynasty Hotel, Taipei, Taiwan

10. **Invited speech:** "Nanowire field-effect transistor-based biosensors: A tool for life science", 2015/6/5–9, *CIMTEC 2016, 5th International Conference of Smart and Multifunctional Materials, Structures and Systems & 11th International Conference of Medical Applications of Novel Biomaterials and Nanotechnology*, Perugia, Italy

Two-Dimensional Nanomaterials-Based Functional Devices for Optoelectronic, Energy Conversion, and Biosensing Applications

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ABSTRACT

Two-dimensional (2D) crystals have emerged as a new class of materials for next-generation ultrathin and flexible optoelectronic devices, because of their unique dimensional-dependent properties. With a mechanical exfoliation method, we fabricated few-layered InSe- and GeS-photodetectors on both a rigid SiO_2/Si substrate and a flexible polyethylene terephthalate (PET) film [1, 2]. These photodetectors are capable of conducting broadband photodetection with high photoresponsivity, excellent external quantum efficiency, superior specific detectivity, and long-term photoswitching stability over a long period of operation. To further demonstrate that white light emission can be generated from vertically stacked few-layered 2D materials-based heterostructures, we grew 2D p-MoS_2/n-MoS_2 vertical heterostructures, where the n-MoS_2 was synthesized first, followed by an epitaxial growth of p-MoS_2 on top of the n-MoS_2 via a control of the growth temperature in chemical vapor deposition (CVD) reaction [3]. For preparing a highly efficient white light emitting diode (WLED), we transferred the hexagram-shaped p-MoS_2/n-MoS_2 on top of a p-GaN bilayer to fabricate a tetra-layered n-MoS_2/p-MoS_2/p-GaN heterostructure, which could emit electroluminescence (EL) in forward bias. The EL spectra comprise three emission peaks centered at 481 nm (from p-GaN), 525 nm (from p-MoS_2), and 642 nm (from n-MoS_2), with a dominant emission peak located at 642 nm. The WLED device composed of the n-MoS_2/p-MoS_2/p-GaN heterostructure showed a luminance of 30,548 cd/m^2, luminescence efficiency of 29 %, and the luminous efficacy of 294 lm/W at a bias voltage of 4 V.

2D crystals can be a promising electrocatalyst for hydrogen evolution reaction (HER) because of their unique nature to supply active sites in the reaction. We synthesized MoS_2 nanosheets on three-dimensional (3D) conductive MoO_2 via a two-step CVD reaction [4]. The 3D MoO_2 structure can create structural disorders in MoS_2 nanosheets (referred to as 3D MoS_2/MoO_2), which are responsible for providing the superior HER activity by exposing tremendous active sites of terminal disulfur of S_2^{-2} (in MoS_2) as well as the backbone conductive oxide layer (of MoO_2) to facilitate an interfacial charge transport for the proton reduction. The high activity of the as-synthesized 3D MoS_2/MoO_2 hybrid material in HER is attributed to the small onset overpotential of 142 mV, a largest cathodic current density of 85 mA cm^{-2}, a low Tafel slope of 35.6 mV dec^{-1}, and robust electrochemical durability. Recently, we also developed a novel, one-step synthesis method to fabricate multi-layer graphene (MLG)-wrapped copper nanoparticles (CuNPs) directly on carbon cloth (CC). The MLG-CuNPs/CC was shown to possess high performance and durability toward HER [5].

To synthesize large-area graphene single crystals, we specifically designed a low-pressure CVD reactor with confined reaction space (L 22 mm × W 13 mm × H 50 μm) [6]. Using this space-confined CVD reactor, we could obtain monolayer, highly uniform, and defect-free graphene single crystals of up to ~0.8 mm in diameter. The as-grown graphene-configured filed-effect transistors (G-FETs) possess the field-effect mobility of ~4800 $cm^2V^{-1}s^{-1}$ at room temperature. Taking advantage of the spacious planar graphene surface, the G-FETs can serve as a biosensor suitable for paving cell membranes that contain the proteins of interest to investigate the membrane-related protein interactions.

KEYWORDS

Chemical vapor deposition, Field-effect transistor, Photodetector, Electrocatalyst, Biosensor

[1] S. R. Tamalampudi *et al.*, Nano Letters **14**, 2800 (2014).

[2] R. K. Ulaganathan *et al.*, Nanoscale **8**, 2284 (2016).

[3] R. D. Nikam *et al.*, Nano Energy **32**, 454 (2017).

[4] R. D. Nikam *et al.*, ACS Apllied Materials & Interfaces **7**, 23328 (2015).

[5] C.-A. Tseng *et al.*, ACS Apllied Materials & Interfaces (DOI: 10.1021/acsami.7b06490) (2017).

[6] C.-C. Chen *et al.*, Chemistry of Materials **27**, 6249 (2015).