

CURRICULUM VITAE (Jan 24, 2019)

LEUNG Wallace Woon-Fong

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Transdisciplinary engineer, educator, researcher, and leader with 40 years of GLOBAL EXPERIENCES including 15-year academic and 25-year industrial experiences. Diversified expertise in application of nanofiber technologies to environment and energy (*air filtration, water/air purification, dye sensitized solar cells, perovskite solar cells*), centrifugal separation/filtration, and mixing in rotating micro-flow:

- **Nanofiber applications (*over 32 SCI papers on nanofibers, 7 US patents*) -**
 - Nanofiber for Perovskite and Dye Sensitized Solar Cells
 - Nanofiber filter for air filtration
 - Nanofiber photocatalysts for breaking-down harmful gases/organics in water
 - Nanofiber for tissue engineering
 - Semiconductor Nanofibers with embedded Graphene
- **Centrifugal separation/filtration (*1 book, 10 new technologies, 36 US patents*)**
- **Biotech separation (*1 book*)**
- **Mixing in micro-chambers/micro-channels (*7 SCI papers*)**

Education:

- **Sc.D., Mechanical Engineering, MIT, Cambridge, MA, USA (1981), *Thesis: A model of Lamella Settler***
- **SM, Mechanical Engineering, MIT, Cambridge, MA, USA (1978), *Thesis: Concentration Polarization in Ultrafiltration under Laminar and Turbulent Flow***
- **BSc., Mechanical & Aerospace Engineering, Cornell University, Ithaca, NY, USA (1977), GPA=4.22/4.30 (graduated first in college of Engineering, finishing BS in 2-1/2 years with 4-year scholarship)**

Professional Societies Membership:

- **Fellow of four professional societies and one academy:**
 - a. American Society of Mechanical Engineers,
 - b. American Institute of Chemical Engineers,
 - c. American Filtration and Separation Society,
 - d. Hong Kong Institution of Engineers
 - e. Hong Kong Academy of Engineering Sciences (Council member 2018-)

International Awards:

1. Gold Award, Geneva Invention, 2017 (semiconductor nanofibers embedded with graphene for energy & environment)
Special congratulations from Jury
2. Hong Kong Polytechnic University Distinguished Knowledge Transfer Excellence Awards (Merit Award in Research)
3. **Frank Tiller Award for life-time contribution in engineering and education on filtration and separations, American Filtration and Separations Society (AFS), 2015 (*presented in AFS Annual Meeting Awards Luncheon, April 28, 2015, Charlotte, North Carolina, USA*)**
4. Gold Award, Geneva Invention, 2014 (multilayer nanofiber filter and added functions)
5. Special Award, Romania Ministry of Education, 2014 (multilayer nanofiber filter and added functions)
6. Wells Shoemaker Award, American Filtration and Separations Society, 2006 (major contribution to the society)
7. Senior Scientist Award, American Filtration and Separations Society, 2002 (technical contribution)
8. Technical Achievement Award, Baker Hughes, 1992, (feed acceleration technology)

9. Cedric Ferguson Medal, Society of Petroleum Engineers, 1987, (2 best papers on water influx to reservoirs, published in Soc. Pet. Eng. J. by researcher under age 33)
10. Sibley Award, Cornell Mechanical & Aerospace Engineering, 1977 (highest graduating GPA)

Licensed Technology:

Multilayer nanofibers (2 IPs) to Avalon Nanofiber Limited. (2014)

ACADEMIC EXPERIENCE

2005-PRESENT

(I) Director, Research Institute of Innovative Products & Technologies (RIIPT), The Hong Kong Polytechnic University

2005-2011

Between 2005 and 2011, Prof. Leung found and directed RIIPT in PolyU collaborating with colleagues from 9 departments (biomedical eng., rehabilitation, applied biology, applied physics, design school, computing, textile, electronics & information, and Industrial Center) researching and developing technologies, first focusing on healthcare needs in society. As a result, a blind navigation technology, a decision support system (DSS), an electro-stimulation with heat and topical drug application for osteoarthritis patients, an interactive robot for stroke patient rehabilitation, biosensors, and biomedical ultrasound have been developed. 59 publications, 25 patent applications, and 11.5 million HKD research funding have been generated by the RIIPT.

Between 2010 and 2011, organized 5 focus teams (air quality, water resources, healthcare, transportation and renewal energy), in HK PolyU, each team having 10-15 academics staff each with multi-disciplines (engineering, science to policy) to bid for large theme-based proposals offered by the Hong Kong Research Grant Council.

(II) Chair Professor of Innovative Products & Technologies, Mechanical Engineering, The Hong Kong Polytechnic University

2005-Present

A. TEACHING

Teaching Portfolio at PolyU (2005 - Present):

Prof. Leung is thermo-fluids discipline **Group Leader** (7 faculties in group) in the Mechanical Eng. department and teaches thermofluids, environmental engineering courses at both undergraduate and graduate levels. His evaluation from student feedback questionnaire on all subjects are higher than average. He organized a summer workshop in 2012 offering two courses on, respectively, internal flow and heat transfer on modern gas turbine engines, enrolled by 27 graduate students, with majority of students from eminent universities in Mainland China including Beihang, Peking U., etc.

Undergraduate level courses:

ME 37001 - Aerodynamics, ME 4413 - Heat and Mass Transfer, ME 4414 - Fluids Engineering (CFD, axial compressors and fans, and fluid-particle processes), ME4411 - Air Conditioning for Indoor Thermal and Environmental Quality

Graduate level courses:

ME556 - Advanced Combustions Systems, ME564 - Air Pollution and Control Devices, and ME588 - Heat Transfer in Modern Gas-Turbine Engines

B. RESEARCH

4 published papers (2013 – present) being selected through UK Research Assessment Exercise by two mock-ups (Mar-July 2018) as world leading in originality, significance and rigor: agenda setting/ primary or essential point of reference:

1. WWF Leung* and Y Ren, “*Scale-up on mixing in rotating microchannel under subcritical and supercritical modes*”, International Journal of Heat and Mass Transfer, 77, 157-172, 2014. (**Mixing in Rotating Micro-channel and chamber**)
2. WWF Leung*, “*Inferring in-situ floc size, predicting solids recovery, and scaling-up using the **Leung number** in separating flocculated suspension in decanter centrifuges*”, Sep. & Purif. Tech. J, 171, 69-79, 2016. (**Centrifugal separation**)

3. CC Pei, KKS Lo, WWF Leung*, "*Titanium-Zinc-Bismuth Oxides-Graphene Composite Nanofibers as High-Performance Photocatalyst for Gas Purification*," Sep. & Purif. Tech. J, 184, 205-212, 2017. (**Nanofiber photocatalysts**)
4. WWF Leung*, WY Hau, HF Choy, "*Microfiber-nanofiber composite filter for high-efficiency and low pressure drop under nano-aerosol loading*", Sep. & Purif. Tech. J, 206, 26-38, 2018. (**Nanofiber air filtration**)

(A) Nanofiber Technology Platform

Organic, inorganic, and natural materials have been electrospun into small-diameter nanofibers 60-300 nm in diameter providing in excess of 66 m²/cm³ of material. The technology has been applied, respectively, to air filtration, gas purification, water purification and treatment, energy harvest, and healthcare applications.

ENVIRONMENT

(1) Air filtration

Submicron aerosols especially nanoparticles less than 100 nm (air borne viruses and diesel pollutants, etc.) can lead to respiratory, cardiovascular and nervous problems. Filters made from nanofibers can be used to effectively remove nano-aerosols by diffusion and interception. However, pressure drop is very high due to the small diameter of nanofibers with large surfaces.

- a. Develop **Multilayer technology** to realize high capture efficiency while reducing pressure drop at least 20-50%.
- b. Develop **Micro-nanofiber composite filter** to improve capture and aerosol-holding capacity for heavy aerosol loading.
- c. Develop **backpulse and backblow** to clean nanofiber filter, develop cyclic cleaning and reloading of nanofiber filters
- d. Develop **capillary filling, aerosol bridging models** and verify with testing to interpret transition from depth to surface filtration
- e. Develop using **CFD in understanding skin formation** in capturing nano-aerosols using nanofiber filter
- f. Develop **electret nanofiber filter**

3 US patents (2012, 2015) were awarded and 16 papers have been published.

(2) Air/gas Purification

Photocatalyst are made into nanofibers providing large surface area for effecting contact with pollutants in air. When the catalyst is photo-activated, free radicals are generated which will oxidize pollutant gases (NO_x, VOC) converting them into harmless molecules, thus purifying the air.

- a. Developed p-type semiconductor TiO₂-ZnO-Bi₂O₃ (TZB) photocatalyst that provides 65% conversion of NO_x.
- b. Developed TZB-Gr that provides 90% conversion of NO_x and 3X conversion of formaldehyde compared to TiO₂ NP. Also photocatalyst performed methylene blue and Rhodamine dye degradation.
- c. Developed n-type TCu, TCu-Gr photocatalysts
- d. Developed TZBG-Cu (hybrid N-P combined) photocatalyst
- e. Develop novel means of affixing photocatalyst onto flexible and hard surfaces

5 papers were published and 1 pending US patent application.

(3) Wastewater Treatment

- a. Photocatalytic nanofibers after activated by light can be used with free radicals generated to oxidize pollutants and organics to harmless substances in waste/polluted water. Photocatalyst made from composite nanofibers with diameter 80 nm provides large surface for effectively oxidizing pollutants.
- b. Integrate membrane filtration with photo-oxidation to remove organics and foulants

1 paper was published and 1 pending US patent application.

ENERGY (Photovoltaics)

(1) **Dye Sensitized Solar Cells (DSSC)**: Unlike conventional DSSC, nanofibers are used to improve electron transport across photoanode.

- a. Light harvesting using co-sensitizer in core-shell structure improves harvesting broad solar spectrum, while also reducing electron-hole recombination loss;
- b. Light scattering using bilayer reduces light loss – published in Adv. Mat. (69 citations)
- c. fast electron transport through nanofibers with carbon nanotubes reduces loss. Cell efficiency for each of these technologies reaches nearly 10%.

5 papers have been published respectively in high-impact Advanced Materials, Nanoscale, and other journals, and 3 US patents secured on technologies.

(2) Perovskite Solar Cells:

- a. Simple chloride via HCl establishes good crystallinity with efficiency reaching 17-18%
- b. Graphene nanofibers improves charge conductivity and providing large crystals with efficiency reaching 20%
- c. TiO₂ nanofiber scaffold with graphene core for improving crystal uniformity and charge transport
- 4 papers have been published and one US patent pending.

HEALTH

Nanofibers made from crustaceans have been deployed in tissue engineering, and wound dressings.

- a. Lab tests revealed that the wound dressing can provide a several-log cycle reduction on *S. aureus* and *E. coli* bacteria.
- b. Cross-linking by chemical and thermos means, the stability and cell attachment of the fiber matt can be improved.
- c. Deliver drugs using nanofiber platform.
- d. Clinical studies in hospitals have proved positive advantages over conventional wound dressings for partial skin grafting on donor sites and on finger-tip injury.

(B) Rotating Microfluidics Platform

Microfluidics can simulate many chemical and biological processes at micro-scale; however, mixing is too slow due to viscous forces. Mixing can be greatly enhanced by generating complex secondary flow from rotation in both batch and continuous-flow microfluidics.

- a. Mixing in micro- and milli-liter chambers (CFD and experiments)
- b. Mixing in straight channels (subcritical and supercritical mode operation)
- c. Mixing in zigzag channels and channels with various obstructions
- d. Cell culture in micro-chamber reduce long lead time for cell growth.

6 papers and 1 US patent.

(C) Centrifugation

- a. Centrifugal separation of flocculated solids in mineral wastewater operation and scale-up (Have analyzed many decanters processing waste with high feed rate)
- b. Centrifugal separation of flocculated solids in municipal wastewater operation and scale-up
- c. Gentle feed acceleration reduction of shear and floc breakup

2 papers published on Leung number scale-up and 36 US patents

(D) Healthcare Devices and Delivery

- a. Develop interactive robot for stroke-patient rehabilitation
- b. Develop electrostimulation together with drug and thermal treatment on osteoarthritis patients
- c. Develop blind navigation
- d. Develop decision support system for cancer patients
- e. Develop smart shelf system

Several papers and 3 US patents have been awarded.

Graduate Research Students and Post-Doctoral Fellows Supervised (since 2009 - present):

Post-Doctoral Fellows supervised:

1. Dr. Yoki Butt (2008-2011), biomarker and proteomics research
2. Dr. Chi-Ho Hung (2010-2011), nanofiber filtration
3. Dr. Lijun Yang (2013 – 2014), solar cells
4. Dr. Jingchuan Wang (2013 – 2014), solar cells
5. Dr. Chun PEI (2015-2016), Photocatalysis using composite nanofibers
6. Dr. Muzafar Kanjwal (2017 – present) - Photocatalysis using composite nanofibers
7. Dr. HF Guo (2017) – CFD of nano-aerosol capture
8. Dr. Furui Tan (2017 – 2018) – Water splitting using TiO₂-graphene composite nanofibers

PhD supervised:

1. Chi-Ho HUNG, *Experimental investigation and Theoretical Analysis on air Filtration of Submicron Aerosols by Nanofiber Filter*, 2010.
2. Fu-Sau CHUNG, *Numerical Simulation of Blood Flow in Stenotic Arteries*, 2011.
3. Yong REN, *Centrifugal Microfluidic Flow and Mixing with Applications in Cell Culture and Cell Lysing*, 2013

4. Lijun YANG, *Fabrication and characterization of High Efficiency Dye Sensitized Solar Cell based on TiO₂ Nanofiber Photoanode*, 2013
5. Chun, PEI, Photocatalysis using composite nanofibers, 2015.

MPhil supervised:

1. Curie HAU, *Cleaning and redistribution of nanoparticles after backpulse and backblow cleaning of a Nanofiber Filter*, 2016.

MSc supervised:

1. XiYu XIAO, Pleated Nanofiber Filter for Removing Submicron Aerosols, Jan 2013.

Current supervised PhD students:

1. Ken LO, *Nanofiber-based DSSC with Graphene*, expected graduating Dec, 2017.
2. Eva MAK, *Chitosan-based nanofiber for tissue engineering and wound healing*, expected graduating Dec, 2017. (Hong Kong Research Grant Council supported PhD Fellowship Graduate, 750,000 HKD stipends, and 129,600 HKD tuition waiver)
3. Yolanda Li, Perovskite solar cell
4. Qiangqiang Sun, Electret nanofibers for air filtration

Projects as Principle Investigator: 2005 – Present

1. High-efficiency, titanium-graphene composite nanofiber photocatalyst integrated into flexible surfaces for improving air purification
2. Numerical modeling of continuous deposition of nanoparticles in a nanofiber filter
3. Blood Flow in Stenotic Arteries with Uncertain Stenoses
4. Loading and Cleaning of A Nanofiber Depth Filter for Capturing Submicron Aerosols
5. Numerical Modelling of Continuous Deposition of Nanoparticles in a Nanofiber Filter and Conversion of the Deposited Particles by Photocatalysis
6. Solid-State Solar Cells with High Conversion Efficiency using Electrospun TiO₂ Nanofiber Photoanode
7. Charge Transport in Perovskite Solar Cell
8. Solid-State Dye Sensitized Solar Cells with High Conversion Efficiency using Electrospun TiO₂ Nanofiber Photoanode
9. Development of Next Generation Multi-layer Chitosan Nanofiber Filters for Medical/Environmental Use with Novel Filtration/Purification Technology
10. High-performance all solution processing perovskite-based solar cells with TiO₂ /CNT nanofiber scaffold
11. Sensing, Control and Combined Drug-Release Electro-Acupuncture Device over Skin (RIIPT)
12. High Performance Solid State DSSC with Perovskite as Light Absorber
13. Investigation of Pressure Drop and Filtration with Nanofiber Filter
14. Optimizing Mixing in Rotational/Centrifugal Microfluidics and Applications to Cell Culture and Cell Lysing
15. Submicron Aerosol Filtration Using Electrostatically Charged Nanofibers
16. Pressure Drop of a Nanofiber Filter
17. Improved Facemask and Hospital Filters with Nanofibers for Capturing Avian (Bird) Flu and SARS Viruses
18. Investigating Loading and Cleaning of a Nanofiber Depth Filter for Capturing Submicron Aerosols
19. Highly Efficient and Permeable Polymer Based Nanofiber Filter Media for Removal of Sub-micron Aerosols Suspended in Air
20. Innovation in Wound Dressing for Improved Wound Healing with Minimized Infection
21. Clinical Decision Support System for Cancer Diagnosis and Treatment

Projects as Co-Principle Investigator: 2005 - 2011

1. From Electronic Gadgets of Bat Ears, Sonar Shoes and GPS to Understanding of the Mind of People with Vision Impairments
2. Bio-mechatronic Therapeutic Robotic System
3. Sensing, Control and Combined Drug-Release Electro-Acupuncture Device over Skin

Research Grant/Funding:

Principle Investigator:	External fund:	6,868,862 HKD
	Internal fund:	6,280,515 HKD
Co-Investigator:	Internal fund:	8,013,500 HKD
Total:		21,162,877 HKD

C. PROFESSIONAL SERVICES

PROFESSIONAL SERVICES: Prof. Leung has served on the Hong Kong Research Grant Council (RGC) 2006-2012 engineering panel for vetting research proposals. From 2006-2009, he served as an advisor to a division of ASTRI (government funded technology transfer institute) in Hong Kong. From 2012 to present, Prof. Leung serves on the Joint Research Scheme for the RGC. In 1993 at Chicago, he organized the American Filtration Society (AFS) annual meeting in combination with North American Membrane Society (NAMS) with 176 papers. In 1999, he organized another large AFS annual meeting in Boston with 165 papers. In 2000, Prof. Leung was the Chairman of the American Filtration Society. He has successfully secured the 9th World Filtration Congress (largest filtration event held once every 4 years) for USA in 2004 to be held in New Orleans, LA. Between 2000-2004, he was the Chairman of the INDEFI (International Delegation on Filtration) organizing successfully the WFC9 in 2004 with over 300 technical papers, 2-day membrane workshop, several short courses on separation/filtration and over 60 exhibits AICHE was among one of the key co-host of the meeting.

Chairman of 13th World Filtration Congress (largest filtration event held once every 4 years) for USA in 2020 to be held in San Diego, CA, USA. Between 2016-2020, he is the Chairman of the INDEFI (International Delegation on Filtration) overseeing different member societies around the world.

CONSULTING SERVICES:

2012 - Present	Syncrude, Alberta, Canada (largest tar sand producer) on separation of tar sand in Alberta, Canada.
2010	Drainage Service Department, Hong Kong on centrifuge for wastewater treatment
2009-2010	Gulf Minerals, Australia for kaolin separation
2008-2011	Celeros, Foxborough, Mass., USA on bioseparation and centrifuge design
2005	OMYA Industries, Florence, Vermont, USA on fine calcium carbonate separation
2004-2005	Thiele Kaolin, Macon, GA, USA on kaolin separation
2004-2005	Waters Technologies, Milford, Mass., USA on resin technologies
2004	Novo Nordisk A/S, Gentofte, Denmark on biotechnology & biopharmaceutical separation
2004	Amgen, Thousand Oaks, CA, USA on biopharmaceutical separation
2004	Tennant, Minneapolis, MN, USA on water treatment

Reviewer for leading journals: Sep. & Purif. Tech., Chem. Eng. Sci, Chem. Eng. J., J. of Phys. Chem., J. Haz. Mat., Adv. Mat., Nanoscale, Nanomicro Letters, Sensor, J. of Heat & Mass Transfer, I&EC, etc.

Received 2 requests on average every week from journals publishing papers on aerosol, filtration, fluid, solar cells, photocatalysis, heat and mass transfer

Keynote speech delivered in Korea, Germany, United States, Japan, Finland, Switzerland, France, China, The Netherlands, and Hong Kong, respectively.

Plenaries in 2018:

Plenary at American Institute of Chemical Engineers Annual Conference Pittsburgh, PA, USA Oct 30 2018

Plenary at European Fluid-Particle Separation Conference, Lyon France, Oct 15-17, 2018.

Plenary at China Nonwoven & Industrial Textiles Association Conference, Shanghai, Sept 5, 2018

Plenary at Korean Filtration Society, Ansan, S. Korea, Feb 29, 2018

INDUSTRIAL EXPERIENCE

1978-2005

Advantech Engineering, Sherborn, MA
President and Founder

2004-2005

Developed centrifuge applications for biotechnology and biopharmaceutical separation. Train engineers and scientists from biopharma, such as Amgen, Nova-Nordisk, Merck, Wyeth and Dow on biotech separations. Developed improved method for centrifugal classification of fine particles. Improved processes, respectively, from Waters, Thiele Kaolin, and Omya.

Baker-Hughes/Bird Machine Company, Walpole, Mass., USA and Cologne, Germany

Senior Research Scientist

1986-1994

Director of Process Technology

1994-2004

Directed R&D team (3 PhD, 2 MS, 1 BS engineers) to R&D via testing (lab, pilot and full scale), modeling and numerical computation separation technologies of centrifuge, drum filter, filter/diaphragm press, tilting pan filter, flotation cell, clarifier, thickener, membrane, leaf filter, and inclined plate settler. Consulted and trouble-shoot process separation problems worldwide.

Developed 11 new centrifuge technologies using tests/experiments, computer simulation, and analytical modeling:

1. Developed **feed acceleration technology** for use in continuous-feed centrifuges. At high feed rate, feed acceleration efficiency increases to 90+% compared with conventional designs which are below 50%. New feed accelerator, respectively, cone/disk/ feed port design can reduce wear, turbulence, and operating costs (especially when polymers are used). Applications for difficult-to-separate micron-sized calcium carbonate, sewage dewatering, fine coal and pipe-line coal, and potash and other applications with advantage of either higher solids capture and/or higher throughput. **These novel technological findings were awarded 15 US patents**, 1991 Engineering Merit Award (Am. Filt. & Sep. Society), and 1992 Baker-Hughes award.
2. Developed **power recovery technology**. Field test of full-scale centrifuge (1100-mm diameter x 4400-mm length) at feed rate in excess of 150 m³/h proved operating power can be reduced by 20+%. This translates to US\$25 million savings over the life of 20+ machines installed in New York City wastewater treatment plant. A US patent (2006) was awarded.
3. Developed **cake-flow control technology** for kaolin classification, calcium carbonate, sewage dewatering, and tar sand with advantage of drier cake (less disposal cost), less polymer usage (lower operating cost), and/or higher capacity (more efficient utilization). 2 US patents (1997) were awarded.
4. Developed **compound-beach centrifuge** for dewatering slurries with micron-sized particles (e.g. calcium carbonate). The technology received the Am. Filt. & Sep. Soc. 2002 best product award and was awarded 3 US patents (1997-2000).
5. Developed **reslurrying-and-separation technology** for screenbowl centrifuge improves cake purity and reduces wash liquid consumption on crysalline solids. The technology was installed in large centrifuges for potash and soda ash applications both in US and Canada. Technology received 3 US patents (1999-2000).
6. Developed **Coriolis-assisted technology** that benefits continuous-feed centrifuges, especially for retrofit machines. This has been tested extensively with success on yeast and fine silica suspension with 3-5 μ m particle sizes. 2 US patents were published (2003-2004).
7. Developed **special conveyor** to improve decanter capacity for dewatering, respectively, Poly-Vinyl Chloride, High-Density Polyethylene, Purified Terephthalic acid (raw material for polyester-textile/clothing), flue gas sludges from coal-fired power plant, coal, and other applications. Plant throughput capacity increased significantly.
8. Developed **smart basket centrifuge** for high-value pharmaceuticals and specialty chemicals with special sensing and control for achieving on-line monitoring of targeted cake dryness which is critical for high-value product in biopharmaceutical production. 3 US patents were awarded (1999-2001).
9. Developed a **combined thickening-and-dewatering cantilever centrifuge** in a small footprint. The new product was used for coal, potash dewatering. 2 US patents were awarded (2001-2003).
10. Developed **combined dewatering-and-drying centrifuge** for sewage sludge. The product received an US patent (2004) and was used in Wastewater Treatment Plants in Europe.
11. Developed (1987) **novel dual-weight and multiple-weight balancing technology** for conveyor of decanter centrifuge, wherein conveyor is balanced under dry (without slurry) and wet (processing slurry) conditions, reducing eccentric excursion/vibration. All conveyors adopted the balancing procedure ever since.

Provide expert advice and consultancy to Process Engineers in Technical Service Department of Bird/Baker-Hughes, for process start-ups and improvements.

Schlumberger, Houston, TX
Development Engineer

1984-1986

- Developed pressure transient test methods to control formation damage near wellbore. Developed Finite Element Analysis flow model for complicated perforation in wellbore for predicting and optimizing oil-and-gas production

Gulf R&D, Pittsburgh, PA and Houston, TX
Research Engineer

1981-1984

- Developed finite difference numerical simulation model for naturally fractured carbonate reservoirs with dual-porosities and dual-permeabilities. Developed water influx prediction for petroleum reservoirs. Cedric Ferguson Medal was awarded for 2 papers published in Soc. Pet. Eng. J. in 1987.

Water Purification Associates, Cambridge, MA

1978 - 1980

- Develop software for water softening processes

Publications and United States Patents (1-2019)
of
Wallace Woon-Fong Leung

(I) Publications: 2 books, 4 handbook chapters, 80 journal papers

(II) Patents: 50 United States patents, 3 patent publications

(I) PUBLICATIONS

The publications cover the following 12 diversified topics:

- A. Centrifugal Separation and Filtration (books, journal papers)**
- B. Dye Sensitized and Perovskite Solar Cells**
- C. Nano-aerosol filtration with Nanofiber filter**
- D. Photocatalysis - Air/water purification with Composite Nanofiber**
- E. Rotating microfluidics - Momentum, mass, and heat transfer with biological, chemical, and physical Applications**
- F. Lattice Boltzmann Method: Modelling Stenosis in blood vessels (Biomedical and Computational)**
- G. Sensors**
- H. Rehabilitation and Medical Sciences**
- I. Centrifugal Filtration and Separations**
- J. Petroleum Production**
- K. Sedimentation and Filtration**
- L. Membrane**

BOOKS AND HANDBOOK CHAPTERS

(A) Centrifugal Separation and Filtration

Books:

- (1) WWF Leung, **Centrifugal Separation in Biotechnology**, Academic Press-Elsevier, Oxford, UK, 2007 (sold 620 copies in first four months), ISBN 13: 978-1-85-617477-0. *Second edition under preparation.*
- (2) WWF Leung, **Industrial Centrifugation Technology**, McGraw-Hill, New York, NY, USA, 430 pp, 1998, ISBN:0-07-037191-1
- (3) WWF Leung, **Nanofiber Filter Technologies in capturing Nano-aerosols**, *under preparation*, 2019.

Handbook Chapters:

- (1) WWF Leung, Centrifuges, **Perry & Green Chemical Engineers' Handbook**, Don Green (editor), 7 ed., pp. 18-106 to 18-125, McGraw-Hill publication, 1997.

(2) WWF Leung, Centrifuges, **Handbook on Separation Techniques for Chemical Engineers**, pp. 4-63 to 4-96, McGraw-Hill publication, 1997.

(3) WWF Leung, *Sedimenting Centrifuges, Scale-up of Solid-Liquid Separation Equipment* by R. Wakeman R. and S. Tartelton, Elsevier, 2005.

(4) WWF Leung, *Centrifugal Separation, Plant Design Handbook for Mineral Processing*, pp. 1262-1288, published by Soc. of Min. Eng., 2002.

JOURNAL PAPERS

(* Corresponding author for paper with multiple authors)

(B) Dye Sensitized Solar Cells with Nanofiber Photoanode & Perovskite Solar Cells (Renewable Energy)

(1) Y Li, WWF Leung*, "Introduction of graphene nanofibers into the perovskite layer of perovskite solar cells," Chemsuschem, doi.org/10.1002/cssc.201800758, 2018.

(2) Y Li, WWF Leung*, "Improving crystallization and charge transfer by using a structured scaffold for perovskite solar cells," *J. Mat. Chem.*, submitted

(3) Y Li, WWF Leung*, "Conditioning Lead Iodide with Dimethylsulfoxide And Hydrochloric Acid to Control Crystal Growth Improving Performance of Perovskite Solar Cell", Solar Energy, Vol 157, pp 328-334, Nov 2017, doi:10.1016/j.solener.2017.08.011.

(4) KKS Lo, WWF Leung*, *Dye-Sensitized Solar Cells with Shear-Exfoliated Graphene Solar Energy*, Solar Energy, 180, 16-24, 2019.

(5) LJ Yang, WWF Leung*, "Electrospun TiO₂ Nanorod with Carbon Nanotube for Efficient Electron Collection in Dye Sensitized Solar Cell", Advanced Materials, 25, #12, 1792-1795, Mar 25, 2013 (IF=19.79)

(6) LJ Yang, WWF Leung*, "Application of a Bilayer TiO₂ Nanofiber Photoanode for Optimization of Dye-Sensitized Solar Cells", Advanced Materials, 23, #39, 4559-4562, Oct 18, 2011 (IF=19.79)

(7) LJ Yang, WWF Leung*, JC Wang, "Improvement of Light Harvesting in Dye Sensitized Solar Cell Based on Cascade Charge Transfer," Nanoscale, 2013, 5 (16), 7493-7498 DOI:10.1039/C3NR01868G, 2013 (IF=7.233)

(8) LJ Yang, WWF Leung*, "A Novel Scattering Layer composed of Electrospayed Polydispersed-size Nanocrystallite TiO₂ for High Efficiency Dye Sensitized Solar Cell", RSC Advances, 3, 25707-25710, 2013, DOI:10.1039/C3RA40865E, Oct 28 2013

(9) LJ Yang, WWF Leung*, "Optimizing scattering layer for efficient dye sensitized solar cells based on TiO₂ nanofiber", Polyhedron, 82, 7-11, 2014. DOI: 10.1016/j.poly.2014.03.029.

(10) LJ Yang, JC Wang, WWF Leung*, "Lead Iodide Thin Film Crystallization Control for High-Performance and Stable Solution-Processed Perovskite Solar Cells", ACS Applied Materials and Interfaces, **2015**, 7 (27), pp 14614–14619. (IF=8.097)

(11) Ren, Z; Ng, A; Shen, Q; Gokkaya, HC; Wang, JC; Yang, LJ; Yiu, WK; Bai, GX; Djurasic, A; Leung, WWF; Hao, JH; Chan, WK; Surya, C, "Thermal Assisted Oxygen Annealing for High Efficiency Planar

- (12) Annie Ng, Zhiwei Ren, Qian Shen, Sin Hang Cheung, Huseyin Cem Gokkaya, Gongxun Bai, Jingchuan Wang, Lijun Yang, Shu Kong So, Aleksandra B. Djurić, Wallace Woon-fong Leung, Jianhua Hao, Wai Kin Chan and Charles Surya*, “*Efficiency enhancement by defect engineering in perovskite photovoltaic cells prepared using evaporated PbI₂/CH₃NH₃P*”, *J. Mater. Chem. A*, 2015, 3, 9223 (**IF=9.931**)

(C) Nano-aerosol filtration with Nanofiber filter (Environmental)

- (13) QQ Sun and WWF Leung*, “*Charged PVDF multi-layer filters with enhanced filtration performance for filtering nano-aerosols*”, *Sep. and Purif. Tech. J.*, doi.org/10.1016/j.seppur.2018.11.063, 212, pp854-876, 2019.
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**(Leung only) – single inventor by Wallace Woon-Fong Leung

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33. Centrifuge with thickened feed accelerator between Inner and Outer Bowl Sections, US patent 6,241,901 June 5, 2001. (Leung only)
34. Method for Separating a Liquid-Solid Slurry (Leung and Frohlich)
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(B) United States Patent Application Publications:

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3. **Liquid Phase Discharge Port Incorporating Chamber Nozzle Device for Centrifuge (Leung only)**, April 15 2004, US Patent Application Publication, US 2004/0072668 A1.

Wallace Woon-Fong Leung Recent Presentations (2014-2019)

Plenaries: 5

Keynotes: 5

Invited Talk: 1

Seminars: 10

Oral Conference Papers: 41

(Jan 2014- 2019)

Plenary Speeches

1. "Filtration of nano-aerosols using nanofiber technologies" inauguration of Korean Filtration Society 1st Annual Meeting, Ansan, Korea, Feb 26-28, 2018.
2. "Nanofiber Technologies in Clean Air" in China Non-woven Association Conference, Shanghai, China, Sep 5, 2018.
3. "Nanofiber filter in aerosol filtration" in European Fluid-Particle Separation Conference, Lyon, France, Oct 15-17, 2018. <http://www.fps2018.com/>
4. "Challenges and Opportunities of Nano-Aerosol Filtration Using Nanofiber Filter", Am. Inst. Chemical Engineers Annual Meeting, Pittsburgh, PA. **Division Plenary: Major Separations Challenges, October 30, 2018.** <https://aiche.confex.com/aiche/2018/meetingapp.cgi/Paper/529719>
5. "Novel Nanofiber Filters for Filtration of Nano-Aerosols", FiltCon, American Filtration and Separations Society Annual Meeting, Philadelphia/Cherry Hill, April 1-4, 2019.

Keynote Speeches

- (1) Nanofiber technologies for use in Energy and Environment, Material Science and Nano-Science Conference, Amsterdam, The Netherlands, Oct 15-17, 2018
- (2) Nanofiber filter for Air Pollution, Beijing, China, April 3, 2014.
- (3) Nanofiber filter technologies for filtering nanoparticles, Filtration Conference, Xiamen, China, Aug 10, 2015.
- (4) Nanofiber for air filtration, Am. Filt and Sep. Soc., San Diego, CA, USA, Oct 25-26, 2016.
- (5) Nanofiber technologies for Energy and Environment, 8th East Asia Mech and Aero Workshop, PoyU, Hong Kong, Dec 1, 2018.

Invited Talk:

Titanium-zinc-bismuth oxides composite nanofibers with embedded graphene as high-performance photocatalyst for gas purification, 3rd conference on Material Sciences and Engineering, Rome, June 14-16, 2018

Seminars

1. **BASF Seminar**, Ludwigshafen am Rhein, **Germany**, Centrifugal separation in biotechnology, May 22, 2018.
2. **Mech Eng. Seminar**, Advances in Nanofiber Filtration of Nano-aerosols, , PolyU, Feb 13, 2018
3. **Mech Eng. Seminar**, Nanofiber photocatalyst in purifying air and water, Mech Eng. Seminar, PolyU, Mar 5, 2018
4. **Technion Chem. Eng. Departmental Seminar:**
Nanofibers in Energy and Environment, May 2016
5. **Technion Mech. Eng. Departmental Seminar:**
Rotating Microfluidics, May 2016
6. **Ben Gurion, Mech Eng. Departmental Seminar:**
Rotating Microfluidics, May 2016
7. **Tel Aviv University , Mech Eng. Departmental Seminar:**
Rotating Microfluidics, May 2016
8. **HKIE Seminar:**
"Breakthrough on Nanofiber Technologies to Air Purification and Solar Cells" by Ir Prof. Wallace Leung, held at PolyU, with sponsorship of ME department, 4-25-2018
9. **Mech Eng. Seminar**, Improvements in perovskite solar cells, Mech Eng. Seminar, PolyU, Oct 25, 2018
10. **Georgia Tech Material Sciences Engineering Seminar**, Nanofiber technologies in Energy and Environment, Jan 3, 2019

Conference Presentations

(1) Wallace Woon-Fong Leung* and Lijun Yang, Electrospun TiO₂ Nanorod with Carbon Nanotube for Efficient Electron Collection in Dye Sensitized Solar Cell, Gordon Conference on Hybrid Electronic & Photonic Materials and Phenomena, Hong Kong University Science and Technology, Hong Kong, June 22-27, 2014.

- (2) Lijun Yang* and Wallace Woon-Fong Leung, Optimizing Scattering Layer for Efficient Dye Sensitized Solar Cells Based on TiO₂ Nanofibers, Gordon Conference on Hybrid Electronic & Photonic Materials and Phenomena, Hong Kong University Science and Technology, Hong Kong, June 22-27, 2014.
- (3) Kenneth Lo* and Wallace Woon-Fong Leung, TiO₂ Nanofibers with Graphene-added for Dye Sensitized Solar Cells, Gordon Conference on Hybrid Electronic & Photonic Materials and Phenomena, Hong Kong University Science and Technology, Hong Kong, June 22-27, 2014.
- (4) Jing-Chuan Wang*, Lijun Yang and Wallace Woon-Fong Leung, Improvement of Light Harvesting in Dye Sensitized Solar Cell Based on Cascade Charge Transfer, Gordon Conference on Hybrid Electronic & Photonic Materials and Phenomena, Hong Kong University Science and Technology, Hong Kong, June 22-27, 2014.
- (5) Wallace Woon-Fong Leung*, Paper 421ac, Separation of Polydispersed Nanoparticles in Suspension, AIChE Annual Meeting, ISBN 978-0-8169-1086-1, Atlanta, GA Nov 16-21, 2014
- (6) Wallace Woon-Fong Leung* and Ren Yong, Paper 73c, Vortical Flow in Rotating Milli- and Micro-Chambers for Mixing and Process Intensification, AIChE Annual Meeting, ISBN 978-0-8169-1086-1, Atlanta, GA Nov 16-21, 2014
- (7) Carina Pei, Wallace Woon-Fong Leung*, Paper 242e, Solar Photocatalytic Oxidation of NO By Electrospun TiO₂/ZnO Composite Nanofiber Mat for Enhancing Indoor Air Quality, AIChE Annual Meeting, ISBN 978-0-8169-1086-1, Atlanta, GA Nov 16-21, 2014
- (8) Wallace Woon-Fong Leung*, Paper 300a, Multilayer Nanofiber Filter Technology for Providing High Filtration Efficiency and Low Pressure Drop, AIChE Annual Meeting, ISBN 978-0-8169-1086-1, Atlanta, GA Nov 16-21, 2014
- (9) Wallace Woon-Fong Leung*, Paper 355c, Supercritical and Subcritical Modes in Mixing in Rotating Microchannel, AIChE Annual Meeting, ISBN 978-0-8169-1086-1, Atlanta, GA Nov 16-21, 2014
- (10) Wallace Woon-Fong Leung*, Paper 594d, Decanter Centrifuges for Kaolin Classification, AIChE Annual Meeting, ISBN 978-0-8169-1086-1, Atlanta, GA Nov 16-21, 2014
- (11) Lijun Yang and Wallace Woon-Fong Leung*, Paper 583h, Nanofiber-Based Dye Sensitized Solar Cells with a Novel Nano-Particle Scattering Layer, , AIChE Annual Meeting, ISBN 978-0-8169-1086-1, Atlanta, GA Nov 16-21, 2014
- (12) Wallace Woon-Fong Leung*, Paper 211f, Centrifugal Separation of Disk Centrifuge in Downstream Processing, AIChE Annual Meeting, ISBN 978-0-8169-1086-1, Atlanta, GA Nov 16-21, 2014
- (13) Carina Pei and Wallace WF Leung*, Enhanced photocatalytic activity of electrospun TiO₂/ZnO nanofibers combination of electrospun nanofibers, Proc. of Nanofibers, Applications and Related Technologies, U of Liberec, Czech Republic, Aug 31-Sep 2, 2015
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