Yushan Fellow Program
Performance Report

University and Appointed Faculty: Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology	**Academic Field:** Engineering
Name of the Yushan (Young) Fellow: Tai-Shung Chung (鍾台生)	■ **Yushan Fellow** □ **Yushan Young Fellow**

Assessment of effectiveness of tangible work

Main points of assessment	The anticipated goals	Concrete work achievements or results	Supporting documents
1. Chief content of the Yushan (Young) Fellows' research work and overview of full research process.	Promote Taiwan R&D; Publish high impact papers; Provide new research directions, capability, and manpower training.	We have published many journal papers (>24), presented data in local and international conferences (>10), set up advanced membrane labs, conducted manpower training and promoted Taiwan.	Appendix 1 Quantitative Assessment Form
2. The link between Yushan (Young) Fellows' future research topics and the university's development and the anticipated benefits (including Higher Education SPROUT Project): (1)Fellows' research plan and goals (2)The link between scholars' research content and the university's development (3)Specific work performance or achievements, please include the mid-term progress report of the particular research plan	Under Profs. Lai, Hu and Hung leadership, the membrane center at NTUST is growing and receiving local and regional attentions. With the joining of Prof. Chung, we aim to promote NTUST membrane R&D globally. The Yushan program would help the membrane center with advanced equipment and capability for membrane studies, material characterizations, and membrane development. In addition to publish high impact journal papers, we aim to bring more impact to increase Taiwan water recycling and CO2 capture,	With the help of Yushan program, we have purchased important equipment such as (1) Zeta potential, (2) goniometer, (3) AFM, (4) optical microscope, (5) spinning machine, (6) syringe pumps and (7) spinnerets. The first three analytic instruments have helped many students and professors in their research. Profs. Hung, Hu, Wang and Tsai, have used these instruments for their publications. In addition, Prof. Chung has published 24 journal papers including 1 paper in Advanced Materials for H2/CO2 separation	Appendix 2 The 13th Conference of the Aseanian Membrane Society (AMS13) had a 3-day special symposium to honor Prof. Chung's lifetime achievements on July 4-6, 2022, in Singapore. Appendix 3 Water Purification: Chung, Tai-Shung - Expertscape.com

Main points of assessment	The anticipated goals	Concrete work achievements or results	Supporting documents
(4)Anticipated goals (including qualitative or quantitative working performance or results) ※ If there is a quantitative work achievements, please fill out "Quantitative Assessment Form"	and promote Taiwan R&D.	and 1 paper in Nature Comm. for saline dewatering and desalination. He also gave several plenary and keynote lectures in local and regional conferences. He was ranked as the top 0.083% of scholars on Water Purification over the past 10 years, as "World Expert" by Expertscape (August 2021).	Appendix 4 List of Journal Publications Appendix 5 Recent Invited Keynotes and Plenary Lectures Appendix 6 List of Conference Presentations
3. Support provided by the university and the project's original goals (please specify the type of support or funds provided by the university to assist in research, such as research equipment and funds, research assistant personnel expenses, accommodation, relocation, children's education assistance, etc.)	Under Profs. Lai, Hu and Hung invitation and Prof. Lai's negotiation with NTUST in 2019/2020, NTUST agreed to provide funding for Prof. Chung with 4 post-doctors and 2 additional professors to strengthen the Yushan program and productivity in addition to the provision of housing and relocation.	So far, none of them (i.e., post-doctors, additional professors) was delivered because the former President had left NTUST in 2020/2021 before Prof. Chung joining. No research assistant was provided either. However, NTUST did provide lab space, good relocation, and housing.	
4. Yushan Fellows ' team cooperation (please list team members and cooperation methods)	The NTUST membrane center consists of at least 7 members including Profs. Lai, Hu, Hung, Wang, Chung, Tsai and Cheng, we have shared the equipment, conducted weekly seminars to co-train our PG students, exchange our ideas and knowledge, and met industrial partners.	The NTUST membrane center has increased its publications from about 78 journal papers in 2020 to about 86 in 2021 since the Yushan program starting on Aug 1, 2021. Prof. Chung also obtained additional grant of $5,405,000 from MOST.	
5. Yushan (Young) Fellow should aim to cooperate and exchange foreign academic resources, which should be linked to university development. It's suggested to make good use of these global academic network resources to assist the internationalization of	Since Prof. Chung came from National University of Singapore (NUS), we aim to continue this connect and have technical exchanges in membrane research and development. We also aim to invite a few experienced	NUS has provided the designs of permeation cells, spinning troughs and others for our labs. We have duplicated them. Prof. Chung was invited by NUS on June 15-July 8 to have technical exchanges on membranes for water recycling and CO2	

Main points of assessment	The anticipated goals	Concrete work achievements or results	Supporting documents
the host university and promote international exchanges and cooperation, including teachers and students exchange activity between universities, international research collaborations, dual degree programs and so on.	post-doctors and young professors from oversea to strength our research capability and productivity.	capture. Prof. Chung also provided connection between NTUST and NUS for some R&D matters. Due to COVID-19, it was hard to have invite foreign scholars to visit Taiwan.	

Appendix 1

Quantitative Assessment Form

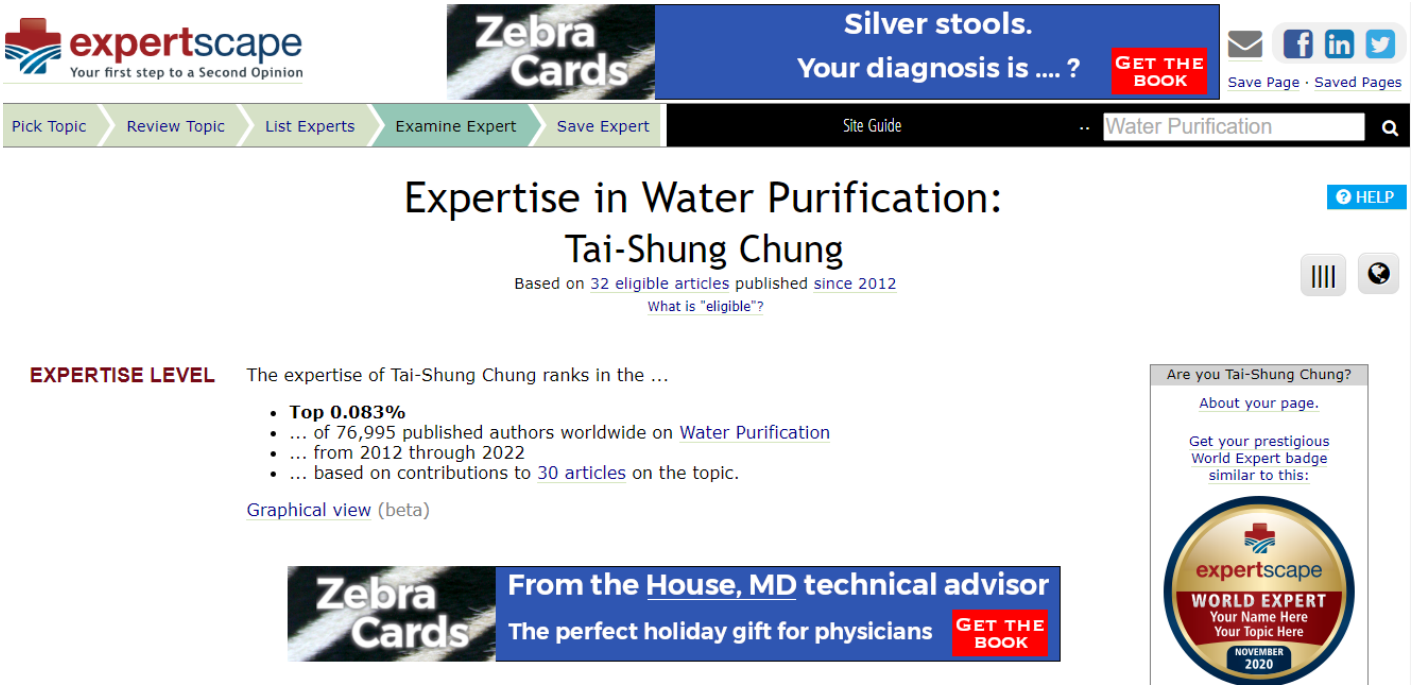
Item		Results and concrete work performance	Explanation
1. Manpower training		Doctoral courses:_____ Graduate courses:_____1_____ Undergraduate courses:_____ Doctoral students:_____3_____ persons Master's students:_____2_____ persons Undergraduate students:____2____ persons Others:__>10_____ persons	Taught "Membrane Science and Technology" in English in 2021. Additional > 10 PG students and research fellows also attended online without formal registration.
2. Papers and research works	Domestic	Journal papers:_____ Academic books and papers in books:_____ Conference papers: _____ Technical reports:_____ Others:___1_____	Gave a 陳芳燦講座邀請演講 at National Taiwan University on May 6 2022
	Overseas	Journal papers:__24_____ Academic books and papers in books:_____ Conference papers: __5 in AMS13___ Technical reports:_____ Others:_____	The 13th Conference of the Aseanian Membrane Society (AMS13) held on July 4-6, 2022, Singapore; Appendix 4 summarizes the publication list.
3. Keynote speaker		___4____panels /sessions	2 for CYCU (Taiwan); 2 for China universities All conducted online.
4. Patents （including patents pending）	Domestic	Quantity: _____	
	Overseas	Quantity: _____	
	□ N/A		
5. Industry-Academia Cooperation		Number of partnered enterprises :_____	Have met industries but it takes time to develop collaborations.
		Number of industry-academia research projects: _____	
6. Technology licensing		Technology licensing cases: _____	
		Total technology licensing royalties （amount）NT$_____	
		□ N/A	
7. Others			

Appendix 2

The 13th Conference of the Aseanian Membrane Society (AMS13) had a 3-day special symposium to honor Prof. Chung's lifetime achievements on July 4-6, 2022, in Singapore.

Appendix 3

Ranked as the top 0.083% of scholars on Water Purification over the past 10 years, as "World Expert" by Expertscape.



Appendix 4

List of Journal Publications

1. C. Z. Liang, M. Askari, L. T. Choong, T. S. Chung, Ultra-strong polymeric hollow fiber membranes for saline dewatering and desalination, *Nature Communications* 12 (2021) 2338. (Impact Factor = 14.919)
2. B. F. Li, S. Japip, J. Y. Lai, T. S. Chung, Revitalize integrally skinned hollow fiber membranes with spatially impregnated 3D-macrocycles for organic solvent nanofiltration, *Chemical Engineering J.* 422 (2021) 130015. (Impact Factor = 13.273)
3. Y. M. L. Chen, K. J. Lu, W. X. Gai, T. S. Chung, Nanofiltration-inspired Janus membranes with simultaneous wetting and fouling resistance for membrane distillation, *Environmental Science & Technology* 55, 7654-7664 (2021). (Impact Factor = 9.028)
4. D. L. Zhao, Q. P. Zhao, T. S. Chung, Fabrication of defect-free thin-film nanocomposite (TFN) membranes for reverse osmosis desalination, *Desalination* 516, 115230 (2021). (Impact Factor = 9.501)
5. Q. P. Zhao, D. L. Zhao, M. H. Nai, S. B. Chen, T. S. Chung, Nanovoids-enhanced thin-film composite reverse osmosis membranes using ZIF-67 nanoparticles as a sacrificial template, *ACS Applied Materials & Interfaces* 13, 33024−33033 (2021). (Impact Factor = 9.229)
6. K. Y. Wang, B. F. Li, T. S. Chung, 3D-Macrocycles impregnated polybenzimidazole hollow fiber membranes with excellent organic solvent resistance for industrial solvent recovery, *Journal of Membrane Science* 638, 119678 (2021). (Impact Factor = 8.742)
7. F. Feng, C. Z. Liang, J. Wu, M. Weber, C. Maletzko, S. Zhang, T. S. Chung, Polyphenylsulfone (PPSU)-based copolymeric membranes: effects of chemical structure and content on gas permeation and separation, *Polymers* 13, 2745 (2021). (Impact Factor = 4.329)
8. A. Raza, S. Japip, C. Z. Liang, S. Farrukh, A. Hussain, T. S. Chung, Novel cellulose triacetate (CTA)/cellulose diacetate (CDA) blend membranes enhanced by amine functionalized ZIF-8 for CO_2 separation, *Polymers* 13, 2946 (2021). (Impact Factor = 4.329)
9. T. S. Yang, K. Y. Wang, T. S. Chung, Fabrication of thin-film composite hollow fiber membranes in modules for concentrating pharmaceuticals and separating sulphate from high salinity brine in the chlor-alkali process, *Journal of Membrane Science* 640, 119822 (2021). (Impact Factor = 8.742)
10. Y. M. L. Chen, L. Kangjia, C. Z, Liang, T. S. Chung, Mechanically strong Janus tri-bore hollow fiber membranes with asymmetric pores for anti-wetting and anti-fouling membrane distillation, *Chemical Engineering Journal* 429, 132455 (2022). (Impact Factor = 13.273)
11. G. M. Shi, Y. N. Feng, B. F. Li, H. M. Tham, J. Y. Lai, T. S., Recent progress of organic solvent nanofiltration membranes, *Progress in Polymer Science* 123, 101470 (2021). (Impact Factor = 29.1)
12. J. Wu, C. Z. Liang, A. Naderi, T. S. Chung, Tunable supramolecular cavities molecularly homogenized in polymer membranes for ultra-efficient precombustion CO_2 capture, *Advanced Materials* 34, 2105156 (2022). (Impact Factor = 32.09)
13. J. Wu, T. S. Chung, Supramolecular polymer network membranes with molecular-sieving nanocavities for efficient pre-combustion CO_2 capture, *Small Methods* 6, 2101288 (2022). (Impact Factor = 15.367)

14. K. J. Lu, C. Z. Liang, Y. M. L. Chen, T. S. Chung, Unlock the secret of air blowing in developing high strength and superhydrophobic membranes for membrane distillation, Desalination 527, 115579 (2022) (Impact Factor = 9.501)

15. Q. P. Zhao, D. L. Zhao, F. Feng, T. S. Chung, S. B. Chen, Thin-film nanocomposite reverse osmosis membranes incorporated with citrate-modified layered double hydroxides (LDHs) for brackish water desalination and boron removal, *Desalination* 527, 115583, (2022) (Impact Factor = 9.501)

16. C. Z. Liang, W. F. Yong, J, Wu, M. Weber, C. Maletzko, J. Y. Lai, T. S. Chung, Plasticization-enhanced trimethylbenzene functionalized polyethersulfone hollow fiber membranes for propylene and propane separation, *Journal of Membrane Science* 647, 120293 (2022). (Impact Factor = 8.742)

17. D. L. Zhao, Q. P. Zhao, H. J. Lin, S. B. Chen, T. S. Chung, Pressure-assisted polydopamine modification of thin-film composite reverse osmosis membranes for enhanced desalination and antifouling performance, *Desalination* 530, 115671 (2022) (Impact Factor = 9.501)

18. B. W. Zhao, G. M. Shi, J. Y. Lai, T. S. Chung, Braid-reinforced polybenzimidazole (PBI) hollow fiber membranes for organic solvent nanofiltration (OSN), *Separation and Purification Technology* 290, 120811 (2022). (Impact Factor = 7.312)

19. K. Y. Wang, M. Weber, T.S. Chung, Polybenzimidazoles (PBIs) and state-of-the-art PBI hollow fiber membranes for water, organic solvent and gas separations: a Review, *Journal of Materials Chemistry A*, **10**, 8687 - 8718 (2022). (Impact Factor = 12.73)

20. M. S. Qua, Y. Zhao, J. Zhang, S. Hernandez, A. T. Paing, K. Mottaiyan, J. Zuo, A. Dhalla, T.S. Chung, C. Gudipati, Novel Sandwich-Structured Hollow Fiber Membrane for High-Efficiency Membrane Distillation and Scale-Up for Pilot Validation, *Membranes* 12, 423 (2022). (Impact Factor = 4.562)

21. Z. F. Gao, J. T. Liu, T. S. Chung, Rapid in-situ growth of covalent organic frameworks on hollow fiber substrates with Janus-like characteristics for efficient organic solvent nanofiltration, *Separation and Purification Technology* 294, 121166 (2022). (Impact Factor = 7.312)

22. T. S. Chung, J. Y. Lai, The potential of calixarenes for membrane separation, *Chemical Engineering Research and Design* (CHERD) 183, 538–545 (2022). (Impact Factor = 4.562)

23. W. P. Li, A. T. Paing, C. A. Chow, M. S. Qua, K. Mottaiyan, K. J. Lu, A. Dhalla, T. S. Chung, C. Gudipati, Scale-up and validation of novel tri-bore PVDF hollow fiber membranes for membrane distillation application for desalination and industrial wastewater recycling, *Membranes* 12, 573 (2022). (Impact Factor = 4.562)

24. F. Qiu, R. Chen, T. S. Chung, Q. C. Ge Forward osmosis for heavy metal removal: Multi-charged metallic complexes as draw solutes, *Desalination* 539, 115924 (2022). (Impact Factor = 9.501)

Appendix 5

Recent Invited Keynotes and Plenary Lectures

1. T. S. Chung, *Membrane applications in the modern water resource management*, (a plenary talk), International Membrane Conference in Taiwan, Chung Yuan Christian University, Taiwan, Oct 30, 2021.
2. T. S. Chung, *Advanced polymer membranes for clean & renewable energy*, Huazhong University of Science and Technology, Wuhan, China Oct 13, 2021.
3. T. S. Chung, *Molecular design of polymer membranes for clean & renewable energy ((1) H_2, CH_4, (2) biofuel, (3) osmotic energy generation* (online seminar), Central South University, Hunan, China, September 16, 2021.
4. T. S. Chung, *My Membrane Research at National University of Singapore (NUS)* (online seminar), Chung Yuan Christian University, Taiwan, August 6, 2021.
5. T. S. Chung, *Polymeric membranes for clean & renewable energy*, 陳芳燦講座邀請演講, National Taiwan University, May 6, 2022.

Appendix 6

List of Conference Presentations

1. C. Z. Liang, W. F. Yong, J. Wu, M. Weber, C. Maletzko, J.Y. Lai, T.S. Chung, Plasticization-enhanced trimethylbenzene functionalized polyethersulfone hollow fiber membranes for propylene and propane separation, 13th Conference of the Aseanian Membrane Society (AMS13), Singapore, 4th - 6th July 2022. (Oral presentation).
2. Z. F. Gao, J. Liu, T.S. Chung, Rapid in-situ growth of covalent organic frameworks on hollow fiber substrates with Janus-like characteristics for efficient organic solvent nanofiltration under $\Delta P = 1$ bar, 13th Conference of the Aseanian Membrane Society (AMS13), Singapore, 4th - 6th July 2022. (Oral presentation-China Session).
3. Feng, C. Z. Liang, J. Wu, M. Weber, C. Maletzko, S. Zhang , T.S. Chung, Polyphenylsulfone (PPSU)-Copolymer Based Membranes: Effects of Chemical Structure and Comonomer Content on Gas Permeation and Separation, 13th Conference of the Aseanian Membrane Society (AMS13), Singapore, 4th - 6th July 2022. (Oral presentation).
4. J. Wu, T. S. Chung, Supramolecular polymer network membranes with molecular-sieving nanocavities for efficient pre-combustion CO_2 capture, 13th Conference of the Aseanian Membrane Society (AMS13), Singapore, 4th – 6th July 2022 (Oral presentation).
5. D. L. Zhao, Q. Zhao, S. B. Chen, T. S. Chung, Molecular design of thin film nanocomposite membranes for desalination, 13th Conference of the Aseanian Membrane Society (AMS13), Singapore, 4th - 6th July 2022. (Oral presentation).