

Luis Francisco Villalobos

Curriculum Vitae

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Education

- Ph.D., Chemical Engineering** **2013–2017**
King Abdullah University of Science and Technology (KAUST), Saudi Arabia
Advisor: Prof. Klaus-Viktor Peinemann
Thesis: Complexation-induced phase separation: Preparation of metal-rich polymeric membranes
- M.S., Chemical and Biological Engineering, Suma Cum Laude** **2011–2012**
King Abdullah University of Science and Technology (KAUST), Saudi Arabia
Advisor: Prof. Klaus-Viktor Peinemann
Thesis: Poly(thiosemicarbazide) membrane for gold adsorption and in-situ growth of gold nanoparticles
- B.S., Chemical Engineering, Summa Cum Laude** **2006–2010**
Universidad Nacional Autónoma de México (UNAM), México

Professional Experience

- Assistant Professor** **Dec 2023 – present**
University of Southern California (USC), United States
- Swiss National Science Foundation Postdoctoral Research Fellow** **Oct 2021 – Nov 2023**
Yale University, United States
Advisor: Prof. Menachem Elimelech
- Postdoctoral Research Fellow** **Sep 2017 – Sep 2021**
École Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Advisor: Prof. Kumar Varoon Agrawal

Research Output – Publications

43. Q. Liu, Y. Miao, L. F. Villalobos, S. Li, H. Y. Chi, C. Chen, M. T. Vahdat, S. Song, D. J. Babu, J. Hao, Y. Han, M. Tsapatsis & K. V. Agrawal, "In-situ solid-state nanopore on single-layer graphene generated from the epoxy group", **Nature Materials**, 22, 1387–1393, 2023
42. L. F. Villalobos, J. Zhang & M. Elimelech, "Nanofiltration for circularity: Fit-for-purpose design and evaluation", **One Earth**, 6, 767–771, 2023
41. L. F. Villalobos, K. E. Pataroque, W. Pan, T. Cao, M. Kaneda, C. Violet, C. L. Ritt, E. M. V. Hoek & M. Elimelech, "Orientation matters: Measuring the correct surface of polyamide membranes with quartz crystal microbalance", **Journal of Membrane Science Letters**, 3, 100048, 2023

40. Y. Bai, B. Liu, J. Li, M. Li, Z. Yao, L. Dong, D. Rao, P. Zhang, X. Cao, L. F. Villalobos, C. Zhang, Q.-F. An, M. Elimelech, "Microstructure Optimization of Bioderived Polyester Nanofilms for Antibiotic Desalination", **Science Advances**, doi.org/10.1126/sciadv.adg6134, 2023
39. M. Dakhchoune, X. Duan, L. F. Villalobos, C. E. Avalos & K. V. Agrawal, "Hydrogen-sieving zeolitic films by coating zeolite nanosheets on porous polymeric support", **Journal of Membrane Science**, 672, 121454, 2023
38. S. Huang*, L. F. Villalobos*, S. Li*, M.T. Vahdat, H. Chi, K.-J. Hsu, V. Boureau & K.V. Agrawal," In-situ solid-state nanopore on single-layer graphene generated from the epoxy group", **Advanced Materials**, 34, 2270353, 2022
[*equal contribution]
37. L. F. Villalobos, D.J. Babu, K.-J. Hsu, C. Van Goethem & K. V. Agrawal, "Gas separation membranes with atom-thick nanopores: The potential of nanoporous single-layer graphene", **Accounts of Materials Research**, doi.org/10.1021/accountsmr.2c00143, 2022
36. M. Rezaei, L. F. Villalobos, K.-J. Hsu & K. V. Agrawal, "Demonstrating and Unraveling a Controlled Nanometer-Scale Expansion of the Vacancy Defects in Graphene by CO₂", **Angewandte Chemie**, 202200321, 2022
35. H.-Y. Chi, C. Chen, K. Zhao, L. F. Villalobos, P. A. Schouwink, L. Piveteau, K. P. Marshall, Q. Liu, Y. Han & K. V. Agrawal, "Unblocking Ion-occluded Pore Channels in Poly(triazine imide) Framework for Proton Conduction", **Angewandte Chemie**, doi.org/10.1002/ange.202207457, 2022
34. W.C. Lee, A. Ronghe, L. F. Villalobos, S. Huang, M. Dakhchoune, M. Mensi, K.-J. Hsu, K.G. Ayappa & K. V. Agrawal, "Enhanced Water Evaporation from Å-scale Graphene Nanopores", **ACS Nano**, doi.org/10.1021/acsnano.2c07193, 2022
33. L. F. Villalobos, C. Van Goethem, K. Hsu, S. Li, M. Moradi, K. Zhao, M. Dakhchoune, S. Huang, Y. Shen, E. Oveisi, V. Boureau & K. V. Agrawal, "Bottom-up synthesis of graphene films hosting atom-thick molecular-sieving apertures.", **Proceedings of the National Academy of Sciences**, 118, e2022201118, 2021
32. M. Dakhchoune, L. F. Villalobos, R. Semino, L. Liu, M. Rezaei, P. Schouwink, C. E. Avalos, P. Baade, V. Wood, Y. Han, M. Ceriotti & K. V. Agrawal, "Gas-sieving zeolitic membranes fabricated by condensation of precursor nanosheets", **Nature Materials**, 20, 362–369, 2021
31. K.-J. Hsu, L. F. Villalobos, S. Huang, H.-Y. Chi, M. Dakhchoune, W.-C. Lee, G. He, M. Mensi & K. V. Agrawal, "Multi-pulsed millisecond ozone gasification for predictable tuning of nucleation and nucleation-decoupled nanopore expansion in graphene for carbon capture", **ACS Nano**, 15, 13230–13239, 2021
30. S. Huang, S. Li, L. F. Villalobos, M. Dakhchoune, M. Micari, D. J. Babu, M. T. Vahdat, M. Mensi, E. Oveisi & K. V. Agrawal, "Millisecond lattice gasification for high-density CO₂- and O₂-sieving nanopores in single-layer graphene", **Science Advances**, 7, eabf0116, 2021
29. L. F. Villalobos, S. Huang, M. Dakhchoune, G. He, W.-C. Lee & K. V. Agrawal, "Polybenzimidazole copolymer derived lacey carbon film for graphene transfer and contamination removal strategies for imaging graphene nanopores", **Carbon**, 173, 980–988, 2021
28. S. Huang, S. Li, K.-J. Hsu, L. F. Villalobos & K. V. Agrawal, "Systematic design of millisecond gasification reactor for the incorporation of gas-sieving nanopores in single-layer graphene", **Journal of Membrane Science**, 119628, 2021
27. M. Dakhchoune, X. Duan, L. F. Villalobos, K.-J. Hsu, J. Zhao, M. Micari & K. V. Agrawal, "Rapid Gas Transport from Block-Copolymer Templated Nanoporous Carbon Films", **Industrial & Engineering Chemistry Research**, 60, 16100–16108, 2021
26. L. F. Villalobos, M. T. Vahdat, M. Dakhchoune, Z. Nadizadeh, M. Mensi, E. Oveisi, D. Campi, N. Marzari & K. V. Agrawal, "Large-scale synthesis of crystalline g-C₃N₄ nanosheets and high temperature H₂ sieving from assembled films", **Science Advances**, 6, eaay9851, 2020

25. G. He, S. Huang, L. F. Villalobos, M. T. Vahdat, M. D. Guiver, J. Zhao, W.-C. Lee, M. Mensi & K. V. Agrawal, "Synergistic CO₂-Sieving from Polymer with Intrinsic Microporosity Masking Nanoporous Single-Layer Graphene", **Advanced Functional Materials**, 30, 2003979, 2020
24. M. T. Vahdat, D. Campi, N. Colonna, L. F. Villalobos, N. Marzari & K. V. Agrawal, "Efficient Kr/Xe separation from triangular g-C₃N₄nanopores, a simulation study", **Journal of Materials Chemistry A**, 8, 17747–17755, 2020
23. G. He, S. Huang, L. F. Villalobos, J. Zhao, M. Mensi, E. Oveisi, M. Rezaei & K. V. Agrawal, "High-permeance polymer-functionalized single-layer graphene membranes that surpass the postcombustion carbon capture target", **Energy & Environmental Science**, 12, 3305–3312, 2019
22. J. Zhao, G. He, S. Huang, L. F. Villalobos, M. Dakhchoune, H. Bassas & K. V. Agrawal, "Etching gas-sieving nanopores in single-layer graphene with an angstrom precision for high-performance gas mixture separation", **Science Advances**, 5, eaav1851, 2019
21. S. Huang, L. F. Villalobos, D. J. Babu, G. He, M. Li, A. Züttel & K. V. Agrawal, "Ultrathin Carbon Molecular Sieve Films and Room-Temperature Oxygen Functionalization for Gas-Sieving", **ACS Applied Materials & Interfaces**, 11, 16729–16736, 2019
20. D. J. Babu*, G. He*, L. F. Villalobos* & K. V. Agrawal, "Crystal Engineering of Metal–Organic Framework Thin Films for Gas Separations", **ACS Sustainable Chemistry & Engineering**, 7, 49–69, 2019
[*equal contribution]
19. F. H. Akhtar, H. Vovushua, L. F. Villalobos, R. Shevate, M. Kumar, S. P. Nunes, U. Schwingenschlögl & K.-V. Peinemann, "Highways for water molecules: Interplay between nanostructure and water vapor transport in block copolymer membranes", **Journal of Membrane Science**, 572, 641–649, 2019
18. F. H. Akhtar, M. Kumar, H. Vovusha, R. Shevate, L. F. Villalobos, U. Schwingenschlögl & K.-V. Peinemann, "Scalable Synthesis of Amphiphilic Copolymers for CO₂- and Water-Selective Membranes: Effect of Copolymer Composition and Chain Length", **Macromolecules**, 52, 6213–6226, 2019
17. A. Bananezhad, M. Jović, L. F. Villalobos, K. V. Agrawal, M. R. Ganjali & H. H. Girault, "Large-scale fabrication of flexible solid-state reference electrodes", **Journal of Electroanalytical Chemistry**, 847, 113241, 2019
16. H. Cheng, Q. Guan, L. F. Villalobos, K.-V. Peinemann, A. Pain & P.-Y. Hong, "Understanding the antifouling mechanisms related to copper oxide and zinc oxide nanoparticles in anaerobic membrane bioreactors", **Environmental Science: Nano**, 6, 3467–3479, 2019
15. L. F. Villalobos, R. Hilke, F. H. Akhtar & K.-V. Peinemann, "Fabrication of Polybenzimidazole/Palladium Nanoparticles Hollow Fiber Membranes for Hydrogen Purification", **Advanced Energy Materials**, 8, 1701567, 2018
14. R. Shevate, M. A. Haque, F. H. Akhtar, L. F. Villalobos, T. Wu & K.-V. Peinemann, "Embedding 1D Conducting Channels into 3D Isoporous Polymer Films for High-Performance Humidity Sensing", **Angewandte Chemie International Edition**, 57, 11218–11222, 2018
13. L. F. Villalobos, T. Huang & K.-V. Peinemann, "Cyclodextrin Films with Fast Solvent Transport and Shape-Selective Permeability", **Advanced Materials**, 29, 1606641, 2017
12. M. Karunakaran, L. F. Villalobos, M. Kumar, R. Shevate, F. H. Akhtar & K.-V. Peinemann, "Graphene oxide doped ionic liquid ultrathin composite membranes for efficient CO₂ capture", **Journal of Materials Chemistry A**, 5, 649–656, 2017
11. F. H. Akhtar, M. Kumar, L. F. Villalobos, H. Vovusha, R. Shevate, U. Schwingenschlögl & K.-V. Peinemann, "Polybenzimidazole-based mixed membranes with exceptionally high water vapor permeability and

selectivity", **Journal of Materials Chemistry A**, 5, 21807–21819, 2017

10. E. Barankova, X. Tan, L. F. Villalobos, E. Litwiller & K.-V. Peinemann, "A Metal Chelating Porous Polymeric Support: The Missing Link for a Defect-Free Metal-Organic Framework Composite Membrane", **Angewandte Chemie International Edition**, 56, 2965–2968, 2017
9. J. Aburabie, L. F. Villalobos & K.-V. Peinemann, "Composite Membrane Formation by Combination of Reaction-Induced and Nonsolvent-Induced Phase Separation", **Macromolecular Materials and Engineering**, 302, 1700131, 2017
8. L. F. Villalobos, Y. Xie, S. P. Nunes & K.-V. Peinemann, "Polymer and Membrane Design for Low Temperature Catalytic Reactions", **Macromolecular Rapid Communications**, 37, 700–704, 2016
7. L. F. Villalobos, S. Chisca, H. Cheng, P.-Y. Hong, S. Nunes & K.-V. Peinemann, "In situ growth of biocidal AgCl crystals in the top layer of asymmetric polytriazole membranes", **RSC Advances**, 6, 46696–46701, 2016
6. H. Cheng, Y. Xie, L. F. Villalobos, L. Song, K.-V. Peinemann, S. Nunes & P.-Y. Hong, "Antibiofilm effect enhanced by modification of 1,2,3-triazole and palladium nanoparticles on polysulfone membranes", **Scientific Reports**, 6, 24289, 2016
5. L. F. Villalobos, M. Karunakaran & K.-V. Peinemann, "Complexation-Induced Phase Separation: Preparation of Composite Membranes with a Nanometer-Thin Dense Skin Loaded with Metal Ions", **Nano Letters**, 15, 3166–3171, 2015
4. L. F. Villalobos, T. Yapici & K.-V. Peinemann, "Poly-thiosemicarbazide membrane for gold recovery", **Separation and Purification Technology**, 136, 94–104, 2014
3. L. F. Villalobos, P. Neelakanda, M. Karunakaran, D. Cha & K.-V. Peinemann, "Poly-thiosemicarbazide/gold nanoparticles catalytic membrane: In-situ growth of well-dispersed, uniform and stable gold nanoparticles in a polymeric membrane", **Catalysis Today**, 236, 92–97, 2014
2. A. Anaya, R. Suárez, F. J. Pacheco, A. S. Garcia & L. F. Villalobos, "Cooling water outlet temperature: Evaluating the best maximum value", **Chemical Engineering**, 119, 46–50, 2012
1. A. Anaya, M. J. De Villafranca, A. S. Garcia, D. Jara, F. J. Pacheco, R. Suárez, J. Sampieri & L. F. Villalobos, "Updating the rules for pipe sizing: The most economical velocity in piping has shifted downward over the last 40 years", **Chemical Engineering**, 117, 48–50, 2010

Research Output - Patents

5. K. V. Agrawal, L. F. Villalobos (2021) International patent application WO/2021/074401 "Crystalline poly(triazine imide) membranes and uses thereof"
4. K. V. Agrawal, D. Babu, L. F. Villalobos (2021) European patent application EP3909669A1 "Method of preparation of porous polymeric support layer and uses thereof"
3. K. V. Peinemann, L. F. Villalobos (2017) U.S. Patent US10696025B2 "Asymmetric polymeric membranes containing a metal-rich dense layer with a controlled thickness and method of making same"
2. K. V. Peinemann, J. Aburabie, L. F. Villalobos (2017) U.S. Patent US10960359B2 "Method of making reaction induced phase separation membranes and uses thereof"
1. K. V. Peinemann, L. F. Villalobos, R. Hilke (2016) U.S. Patent US10450632B2 "Chelating polymeric membranes"

Awards and Honors

10. Discovery Early Career Researcher Award (DECRA) – Australian Research Council 2022
 9. Young Membrane Scientist Award – North American Membrane Society 2022
 8. Postdoc.Mobility Fellow – Swiss National Science Foundation 2021
 7. Outstanding PhD Student Award – KAUST 2017
 6. Poster Presentation Award – KAUST New Materials Horizon for Energy-Intensive Industrial 2017
 5. Graduated Summa Cum Laude at KAUST, based on GPA of 4.0 on a 4.0 scale 2012
 4. Provost Award – KAUST 2012
 3. Discovery scholarship – KAUST 2011
 2. Graduated Summa Cum Laude at UNAM, based on GPA of 9.7 on a 10.0 scale 2010
 1. Three years in a row Top Student Award during my BSc degree – UNAM 2008, 2009 & 2010
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Lectures and poster presentations

Invited Lectures

13. Seminar – University of Newcastle May 2023 – online
12. Seminar – University Minnesota, Twin Cities Feb 2023 – Minneapolis, MN
11. Seminar – University California, San Diego Feb 2023 – San Diego, CA
10. Seminar – University of Southern California Feb 2023 – Los Angeles, CA
9. Seminar – Rochester University Jan 2023 – Rochester, NY
8. Seminar – Stanford University Jan 2023 – Palo Alto, CA
7. Seminar – DOE EFRC Center for Enhanced Nanofluidic Transport Jan 2023 – online
6. Seminar – University of Wisconsin–Madison Jan 2022 – Madison, WI
5. Seminar – Pall Corporation Dec 2022 – online
4. Seminar – New Jersey Institute of Technology Dec 2022 – Newark, NJ
3. Young Membrane Scientist Award lecture, North American Membrane Society (NAMS) May 2022 – Phoenix, Arizona
2. Yale’s Robert M. Langer Annual Symposium December 2021 – New Haven, Connecticut
1. AMPMC/KAUST Research Conference February 2015 – Thuwal, Saudi Arabia

Lectures at International Conferences

12. AIChE (American Institute of Chemical Engineers) Meeting November 2021 – Boston, Massachusetts
11. ICOM (International Conference on Membranes and Membrane Processes) December 2020 – Online
10. AIChE (American Institute of Chemical Engineers) Meeting November 2021 – Online
9. NAMS (North American Membrane Society Meeting) May 2020 – Online
8. IZMM (International Zeolite Membrane Meeting) June 2019 – Lulea, Sweden
7. ICOM (International Conference on Membranes and Membrane Processes) July 2017 – San Francisco, USA
6. MRS (Materials Research Society Meeting) April 2017 – Phoenix, USA
5. NAMS (North American Membrane Society Meeting) May 2016 – Bellevue, USA
4. PACIFICHEM (The International Chemical Congress of Pacific Basin Societies) December 2015 – Honolulu, USA
3. NAMS (North American Membrane Society Meeting) June 2015 – Boston, USA
2. ICOM (International Conference on Membranes and Membrane Processes) July 2014 – Suzhou, China
1. ICCMR (International Conference on Catalysis in Membrane Reactors) July 2013 – Porto, Portugal

Poster presentations

9. Tahoe Nanofluidics May 2022 – Lake Tahoe, Nevada
 8. SCS (Swiss Chemical Society) September 2019 – Zurich, Switzerland
 7. GRC Nanoporous Materials and Their Applications August 2019 – New London, USA
 6. SCS (Swiss Chemical Society) August 2018 – Lausanne, Switzerland
 5. Euromembrane July 2018 – Valencia, Spain
 4. KAUST New Materials Horizon for Energy-Intensive Industrial Separations Conference February 2017 – Thuwal, Saudi Arabia
 3. GRC Membranes: Materials & Processes July 2014 – New London, USA
 2. KAUST Polymer Conference November 2013 – Thuwal, Saudi Arabia
 1. Dow Sustainability Innovation Student Challenge October 2013 – Thuwal, Saudi Arabia
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Teaching and Mentoring

Teaching

- Lead instructor for the course Introduction to Separation Processes (ChE 350) USC, Spring 2024
- Invited instructor for the course Chemical Product Design (ChE 413) EPFL, Fall 2020

Mentoring

I have trained, co-supervised and mentored **15 students (nine PhD, four MS, and two interns) and one postdoctoral researcher** to conduct state-of-the-art scientific research on different membrane-related projects. The students and the postdoc I have mentored consistently publish as first authors in top-tier journals such as *Nature Materials*, *Science Advances*, *Proc. Natl. Acad. Sci. U.S.A.*, *ACS Nano*, and *Angewandte Chemie*. The three PhD students I co-supervised for almost their entire degree have received multiple awards (e.g., North America Membrane Society's student fellowship award and best oral presentation award in the fall meeting of the Swiss Chemical Society) and have now moved to stimulating positions (one as a SNSF postdoctoral fellow in a Nobel Laureate's lab [Prof. Sir Andre K. Geim], one as a co-founder of a membrane company, and one as a 2022 Schmidt Science Fellow).

Academic Services and Leadership

9. Reviewer for Scholarly Journals
Science Advances, ACS Applied Materials & Interfaces, Journal of Membrane Science, Chemistry – A European Journal, ACS Macro Letters, Chemical Engineering Science, ACS Sustainable Chemistry & Engineering, Polymers, and Membranes.
8. Session Chair
Inorganic Materials session of the 2022 NAMS Meeting (in person)
Inorganic Membranes session of the 2021 AIChE Meeting (in person)
Inorganic Materials session of the 2021 NAMS Meeting (on-line)
7. Co-organizer of Yale's 2022 Equity in the Job Search Symposium
6. Committee member for Yueqing Sheng's MS Thesis defense (EPFL, 2022)
5. Co-organizer and Instructor of a water desalination workshop for Technion-bound Israeli students visiting Yale
4. Laboratory safety coordinator of my group at EPFL (August 2018 to January 2021)
3. Poster Judge on several occasions for the Student Poster Competition in the NAMS and ICOM meetings
2. Member of the Center for Enhanced Nanofluidic Transport; a virtual center funded by DOE EFRC
1. Affiliated to the North American Membrane Society, the American Institute of Chemical Engineers, the Materials Research Society, and the Swiss Chemical Society

