
Luis Francisco Villalobos, PhD

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Research Interest

Development of the next-generation, energy-efficient membrane-based separation processes for the recovery of resources (materials and energy) from waste streams.

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 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 2006-2010
Universidad Nacional Autónoma de México (UNAM), México

Professional Experience

- Swiss National Science Foundation Postdoctoral Research Fellow Oct 2021- present
Yale University, USA
Advisor: Prof. Menachem Elimelech
- Postdoctoral Research Fellow Sep 2017- Sep 2021
École Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Advisor: Prof. Kumar Varoon Agrawal
- Laboratory safety coordinator Aug 2018- Jan 2021
École Polytechnique Fédérale de Lausanne (EPFL), Switzerland

Publications

1. 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
2. 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
3. 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
4. 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
5. 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
6. 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
 7. 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
 8. 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
 9. M. T. Vahdat, D. Campi, N. Colonna, L. F. Villalobos, N. Marzari & K. V. Agrawal, "Efficient Kr/Xe separation from triangular g-C₃N₄ nanopores, a simulation study", **Journal of Materials Chemistry A**, 8, 17747–17755, 2020
 10. 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
 11. 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
 12. 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
 13. 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*]
 14. 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
 15. 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
 16. 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
 17. 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
 18. 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
 19. 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
 20. L. F. Villalobos, T. Huang & K.-V. Peinemann, "Cyclodextrin Films with Fast Solvent Transport and Shape-Selective Permeability", **Advanced Materials**, 29, 1606641, 2017
 21. 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
 22. 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
 23. 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
24. 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
 25. 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
 26. 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
 27. 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
 28. 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
 29. L. F. Villalobos, T. Yapici & K.-V. Peinemann, "Poly-thiosemicarbazide membrane for gold recovery", **Separation and Purification Technology**, 136, 94–104, 2014
 30. 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
 31. 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
 32. 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

Patent and Patent Applications

1. K. V. Agrawal, D. Babu, L. F. Villalobos, "Method of preparation of porous polymeric support layer and uses thereof", Application EP20174809.2
2. K. V. Agrawal, L. F. Villalobos, "Crystalline poly(triazine imide) membranes and uses thereof", Application EP19203932.
3. K. V. Peinemann, J. Aburabie, L. F. Villalobos, "Method of making reaction induced phase separation membranes and uses thereof", Application US20170225127A1
4. K. V. Peinemann, L. F. Villalobos, "Asymmetric polymeric membranes containing a metal-rich dense layer with a controlled thickness and method of making same", Application WO2016009272A1
5. K. V. Peinemann, L. F. Villalobos, R. Hilke, "Chelating polymeric membranes", Application US10450632B2

Talks

1. ICOM (International Conference on Membranes and Membrane Processes) December 2020 – Online
2. NAMS (North American Membrane Society Meeting) May 2020 – Online
3. IZMM (International Zeolite Membrane Meeting) June 2019 – Lulea, Sweden
4. ICOM (International Conference on Membranes and Membrane Processes) July 2017 – San Francisco, USA
5. MRS (Materials Research Society Meeting) April 2017 – Phoenix, USA
6. NAMS (North American Membrane Society Meeting) May 2016 – Bellevue, USA
7. PACIFICHEM (The International Chemical Congress of Pacific Basin Societies) December 2015 – Honolulu, USA
8. NAMS (North American Membrane Society Meeting) June 2015 – Boston, USA
9. AMPMC/KAUST Research Conference February 2015 – Thuwal, Saudi Arabia

10. ICOM (International Conference on Membranes and Membrane Processes) July 2014 – Suzhou, China
11. ICCMR (International Conference on Catalysis in Membrane Reactors) July 2013 – Porto, Portugal

Poster presentations

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

Awards and Honors

1. Swiss National Science Foundation (SNSF) Postdoc.Mobility Fellowship
2. PSE Division Outstanding PhD Student Award
3. Poster Presentation Award – KAUST New Materials Horizon for Energy-Intensive Industrial
4. Research featured in Nature Middle East
5. Research featured in KAUST Discovery Magazine (published bi-annually showcasing the best of KAUST research)
6. KAUST Provost Award
7. KAUST Discovery scholarship
8. Three years in a row Top Student Award during my BSc degree (2008, 2009 & 2010)

Professional Affiliations

1. Materials Research Society (MRS)
2. North American Membrane Society (NAMS)
3. American Institute of Chemical Engineers (AIChE)
4. Swiss Chemical Society (SCS)

Peer Review Activities

1. Science Advances
2. ACS Applied Materials & Interfaces
3. Journal of Membrane Science
4. Chemistry – A European Journal
5. Chemical Engineering Science
6. Polymers
7. Membranes