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EDUCATION

Postdoctoral research, University of California at Berkeley
Ph.D., Rutgers, The State University of New Jersey, Chemical Engineering, September 2000
B.S., High Honors, Rutgers, The State University of New Jersey, Chemical Engineering, May 1995

RESEARCH EXPERIENCE

Postdoctoral Research Associate, University of California at Berkeley

Department of Chemical Engineering, January 2003 - Present

Project: *Simulation Methods for Complex Reacting Systems*

Advisor: Prof. Enrique Iglesia

Key Accomplishments

- Resolved reaction pathways and reasons for yield limitations in the NO_x-assisted selective oxidation of CH₄ to C₁-oxygenates.
- Merged hydrodynamic, kinetic and transport descriptions in simulations of coupled endothermic/exothermic methane reactions in membrane and plate-type reactors and performed optimization and sensitivity analysis.
- Exploited Monte Carlo methods to study bulk, transition and Knudsen diffusion in complex porous solids and related the relevant length scale for Knudsen diffusion to void structure.
- Implemented a novel algorithm for random walks on pore walls to quantify the surface tortuosity factor in model porous solids typical of adsorbents, membranes, and catalyst supports.

Research & Development Engineer, Catalytica Energy Systems, Mountain View, CA

New Applications Group, September 2000 - January 2003

Project: *Development of an On-Board Fuel Processor for Automotive PEM Fuel Cells*

Key Accomplishments

- Developed detailed reactor models including kinetics and heat and mass transfer in catalytic reactors based on plate-type heat exchangers.
- Demonstrated maximum H₂ yields attainable in steam reforming and water-gas shift using counter-flow operation, catalyst staging and optimal temperature control.
- Experimentally discovered stability issues related to Pt/ceria catalysts for CO reduction via water-gas shift that led to a redirection of catalyst development efforts.

Doctoral Student, Rutgers, The State University of New Jersey, New Brunswick, NJ

Department of Chemical and Biochemical Engineering, September 1995 - September 2000

Advisor: Prof. Fernando Muzzio

Dissertation: *Computational Fluid Dynamics Tools for Investigating Flow and Mixing in Industrial Systems*

Key Accomplishments

- Developed a framework for studying laminar flow and mixing in 3D systems using computational fluid dynamics (CFD) and dynamical systems theory.
- Proved that laminar flow is almost globally chaotic and mixing occurs by a self-similar process in SMX static mixers over a broad range of Reynolds numbers.
- Exposed the mechanism of mixing in laminar stirred tanks by quantifying mixing dynamics and the statistics of partially mixed structures in computed flow fields.
- Identified mixing barriers in multiple-impeller stirred tanks and suggested alternative designs for improved performance.

Summer Intern, Exxon Research & Engineering Company, Annandale, NJ

Corporate Research, May - August 1995

Advisor: Dr. Sebastián C. Reyes

Project: *Detailed Modeling of Monolithic Catalytic Reactors for Syngas Generation*

Key Accomplishments

- Incorporated a large surface reaction mechanism into a model of a heterogeneous catalytic reactor for methane conversion.
- Investigated the influence of process parameters on H₂ yield and selectivity and temperature gradients.

TEACHING EXPERIENCE

Teaching Assistant, Rutgers, The State University of New Jersey, New Brunswick, NJ

Department of Chemical and Biochemical Engineering, Kinetics, Catalysis, and Reactor Design (graduate course), Spring 1998

Department of Chemical and Biochemical Engineering, Introduction to Chemical Engineering (undergraduate course), Fall 1995, Spring 1996

HONORS & AWARDS

NSF Fellowship (1996-1999)

Exxon Research and Engineering Company Merit Scholarship (1995 - 1996)

Tau Beta Pi (1994)

Dean's Merit Scholarship, Rutgers College of Engineering (1991 - 1993)

Edward J. Bloustein Award, State of New Jersey (1991 - 1993)

Acceptance into Rutgers College of Engineering Honors Program (1991)

PROFESSIONAL SOCIETIES

American Chemical Society
American Institute of Chemical Engineers

PUBLICATIONS

15. J.M. Zalc, W.H. Green, and E. Iglesia, "NO_x-Mediated Homogeneous Pathways for the Synthesis of Oxygenates from Methane-Oxygen Mixtures", *submitted to Journal of Physical Chemistry B*.
14. J.M. Zalc, S.C. Reyes, and E. Iglesia, "The Influence of Diffusion Regime and Void Structure on Transport Rates and Tortuosity Factors in Complex Porous Structures", *Chemical Engineering Science*, 59(14), 2947-2960.
13. J.M. Zalc, S.C. Reyes, and E. Iglesia, "Monte Carlo Simulations of Surface and Gas Phase Diffusion in Complex Porous Structures", *Chemical Engineering Science*, 58(20), 4605-4617, 2003.
12. J.M. Zalc, E.S. Szalai, M.M. Alvarez, and F.J. Muzzio, "Using CFD to Understand Chaotic Mixing in Laminar Stirred Tanks", *AIChE Journal*, 48(10), 2124-2134, 2002.
11. M.M. Alvarez, J.M. Zalc, T. Shinbrot, P.E. Arratia, and F.J. Muzzio, "Mechanisms of Mixing and Creation of Structure in Laminar Stirred Tanks", *AIChE Journal*, 48(10), 2135-2148, 2002.
10. J.M. Zalc, E.S. Szalai, and F.J. Muzzio, "Mixing Dynamics in the SMX Static Mixer as a Function of Injection Location and Flow Ratio", *Polymer Engineering and Science*, 43(4), 875-890, 2003.
9. J.M. Zalc and D.G. Löffler, "Fuel Processing for PEM Fuel Cells: Transport and Kinetic Issues of System Design", *Journal of Power Sources*, 111(1), 58-64, 2002.
8. M.M. Alvarez-Hernández, T. Shinbrot, J.M. Zalc, and F.J. Muzzio, "Practical Chaotic Mixing", *Chemical Engineering Science*, 57(17), 3749-3753, 2002.
7. J.M. Zalc, E.S. Szalai, F.J. Muzzio, and S. Jaffer, "Characterization of Flow and Mixing in an SMX Static Mixer", *AIChE Journal*, 48(3), 427-436, 2002.
6. J.M. Zalc, M.M. Alvarez, B.E. Arik, and F.J. Muzzio, "Extensive Validation of Computed Laminar Flow Fields in a Stirred Tank Equipped with Three Rushton Turbines", *AIChE Journal*, 47(10), 2144-2154, 2001.

5. J.M. Zalc, V.D. Sokolovskii, and D.G. Löffler, "Are Noble Metal-Based Water-Gas Shift Catalysts Practical for Automotive Fuel Processing?", *Journal of Catalysis*, 206(1), 169-171, 2002.
4. T. Shinbrot, M.M. Alvarez, J.M. Zalc, and F.J. Muzzio, "Attraction of Minute Particles to Invariant Regions of Volume Preserving Flows by Transients", *Physical Review Letters*, 86(7), 1207-1210, 2001.
3. S. Cerbelli, J.M. Zalc, and F.J. Muzzio, "The Evolution of Material Lines Curvature in Deterministic Chaotic Flows", *Chemical Engineering Science*, 55(2s), 363-371, 2000.
2. J.M. Zalc, M.M. Alvarez, and F.J. Muzzio, "Simulation of Flow and Mixing in Stirred Tank Reactors", *ASME PVP-Computational Technologies for Fluid/Thermal/Structural/Chemical Systems with Industrial Applications*, 397(2), 233-245, 1999.
1. J.M. Zalc and F.J. Muzzio, "Parallel-Competitive Reactions in a Two-Dimensional Chaotic Flow", *Chemical Engineering Science*, 54(8), 1053-1069, 1999.

CONFERENCE PRESENTATIONS

10. J.M. Zalc, W.H. Green, and E. Iglesia, "NO_x-Mediated Homogeneous Pathways for the Synthesis of Oxygenates from Methane-Oxygen Mixtures", 2004 AIChE Annual Meeting, Austin, Texas, U.S.A.
9. J.M. Zalc, J. Wei, and E. Iglesia, "Optimal Design Strategies for Coupling Endothermic/Exothermic Methane Reactions Using Detailed Reactor Modeling", 7th Natural Gas Conversion Symposium 2004, Dalian, China.
8. J.M. Zalc, S.C. Reyes, and E. Iglesia, "Simulations of Surface and Gas Phase Transport in Random Porous Solids", Paper 275b, 2003 AIChE Annual Meeting, San Francisco, California, U.S.A.
7. J.M. Zalc, H. Liu, and R.A. Dalla Betta, "System Integration Issues for a Plate Reactor-Based Automotive Fuel Processor", Paper 390a, 2002 AIChE Annual Meeting, Indianapolis, Indiana, U.S.A.
6. J.M. Zalc, T. Park, V.D. Sokolovskii, and D.G. Löffler, "Optimal Design of a Water-Gas Shift Reactor for Use in Automotive Applications", Paper 167a, 2001 AIChE Annual Meeting, Reno, Nevada, U.S.A.
5. J.M. Zalc, V.D. Sokolovskii, and D.G. Löffler, "A Catalyst System for Autothermal Reforming of Sulfur-Laden Diesel Fuel", Paper 323d, 2001 AIChE Annual Meeting, Reno, Nevada, U.S.A.

4. J.M. Zalc, M.M. Alvarez, and F.J. Muzzio, "Validated CFD Tools for Laminar Mixing Simulations in Stirred Tank Reactors", Paper 164h, 1999 AIChE Annual Meeting, Dallas, Texas, U.S.A.
3. J.M. Zalc, M.M. Alvarez, and F.J. Muzzio, "Simulation of Laminar Flow and Mixing in Stirred Tank Reactors", Paper 4.2K, 1999 ASME Pressure Vessels and Piping Conference, Boston, Massachusetts, U.S.A.
2. J.M. Zalc and F.J. Muzzio, "The Effect of Mixing on By-Product Distribution of Parallel-Competitive Reactions", 1998 Environmentally Benign Chemical Processing Workshop, University of Virginia, Virginia, U.S.A.
1. J.M. Zalc and F.J. Muzzio, "Parallel-Competitive Reactions in Two-Dimensional Chaotic Flows", Paper 207b, 1997 AIChE Annual Meeting, Los Angeles, California, U.S.A.

REFERENCES

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