UCMERCED | CHEMISTRY & BIOCHEMISTRY

DATE: 10/02/2025 | TIME: 01:30pm | LOCATION: ADMIN 350

CHEMISTRY & BIOCHEMISTRY SEMINAR SERIES:

Directing behavior at solid-liquid interfaces: Using solvents and surfaces to control heterogeneous catalytic reactions

Abstract:

The ability to use of renewable chemical feedstocks at scale will require heterogeneous catalysts optimized for processing volatile, fossil-fuel-derived hydrocarbons to be adapted to handle non-volatile renewable and recycled organic molecules in the liquid phase. Solvent effects arising from covalent and non-covalent interactions alter behaviors at surfaces and especially in porous materials, where interactions are strongly influenced by partitioning of molecules between the bulk liquid phase and the surface or pore volume. Nanoscale structuring of solvent molecules near these surfaces can promote or impede adsorption of molecules near active sites [1,2]. By probing these effects at a molecular level using operando magic-angle-spinning (MAS) NMR [3], we explore the origins of solvent-induced activity and selectivity effects in heterogeneous catalysis. Specifically, organic solvents enhance the sorption of water and solute molecules in zeolite pores [1]. The effect is amplified in hydrophilic pores and suppressed in hydrophobic pores [4]. The result can be strongly non-monotonic solvent-induced changes in catalytic activity due to selective partitioning.

References

[1] L. Qi, R. Alamillo, W. A. Elliot, A. Andersen, D. W. Hoyt, E. D. Walter, K.-S. Han, N. M. Washton, R. M. Rioux, J. A. Dumesic, S. L. Scott, ACS Catal. 7, 3489 (2017).

[2] H. Moon, S. Han, S. L. Scott, Chem. Sci., 11, 3702 (2020); H. Moon, R. P Collanton, J. I Monroe, T. M. Casey, M. S. Shell, S. Han, S. L. Scott, J. Am. Chem. Soc. 144, 1766 (2022).

[3] E. D. Walter, L. Qi, A. Chamas, H. S. Mehta, J. A. Sears, S. L. Scott, D. W. Hoyt, J. Phys. Chem. C, 122, 8209 (2018).

[4] J. A. Chalmers, H. Moon, S. F. Ausman, C.-H. Chuang, S. L. Scott, Top. Catal. 66, 1143 (2023).

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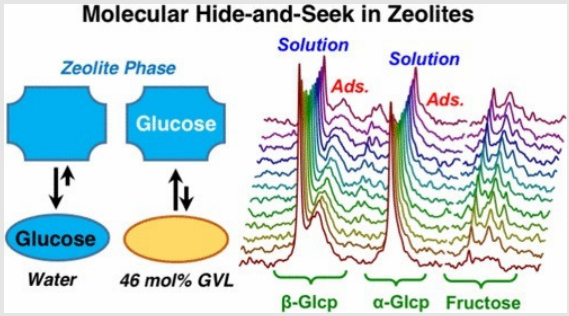

About the Speaker:

Susannah Scott is a Distinguished Professor in both Chemical Engineering and in Chemistry & Biochemistry at the University of California, Santa Barbara. She received her Ph.D. in Inorganic Chemistry from Iowa State University, under the direction of Jim Espenson and Andreja Bakac, for her work on the activation of O2 and transition metal-catalyzed oxidation mechanisms. She was awarded a NATO Postdoctoral Fellowship for work with Jean-Marie Basset at the Institut de recherches sur la catalyse (CNRS) in Lyon, France. In 1994, she joined the faculty of the University of Ottawa (Canada), where she was named a Canada Research Chair. In 2003, she moved to the University of California, Santa Barbara, where she currently holds the Duncan and Suzanne Mellichamp Chair in Sustainable Catalysis. She is an Executive Editor for ACS Catalysis, and a member of the Board of Reviewing Editors for Science. Her research interests include the design of heterogeneous catalysts with well-defined active sites for the conversion of conventional and unconventional carbon-based feedstocks, including the use of renewable and recycled carbon; methods for the operando spectroscopic characterization of catalysts and the study of reaction mechanisms; and decarbonization strategies for the chemical industry.

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