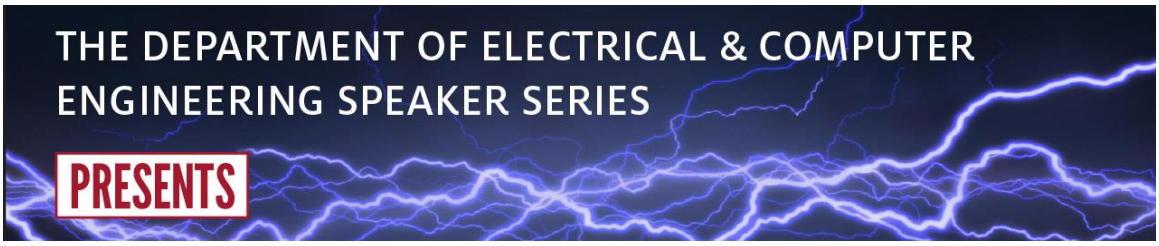

Computer Chips as the Catalyst of the Future: The Catalytic Mechanics of Dynamic Surfaces

Paul J. Dauenhauer,
Professor
Department of Chemical Engineering and Materials Science, University of Minnesota.

Monday, 04.19.2021, 9:55am

Zoom link: https://uofh.zoom.us/j/94318422593

LECTURE ABSTRACT

The emergence of competitive renewable energy from sunlight and wind heightens the importance of moving and storing energy from the place of origin to the locations where people live and work. Chemically capturing energy as compressed hydrogen or energy liquids including hydrocarbons and ammonia remains a leading method of energy storage based on density and fungibility, but the catalytic technology necessary for transformation of electricity into chemicals in small, distributed energy systems is the key challenge for implementation. In this work[1], we propose to utilize electronically tunable catalytic surfaces (catalytic field effect transistors or CATFETS) to promote the reactions of hydrogen production and hydrogen storage as ammonia. The general approach of dynamic catalyst operation is described as oscillatory binding energy of adsorbates on active sites as a method to dramatically accelerate the rate of catalytic reaction. Surface oscillations in sinusoidal and square waveforms of transient binding energy are imposed on catalyst surfaces with varying amplitude and frequency to identify the resonance conditions leading to 10,000x enhancement in overall reaction rate. The results are presented in the context of catalyst-reaction behavior and with regard to implementation in industrial reactor technologies necessary for moving and storing renewable energy[2].

SPEAKER BIOSKETCH

Paul Dauenhauer received a bachelor of science in chemical engineering and chemistry from the University of Wisconsin - Madison in 2004, and a Ph.D. in chemical engineering from the University of Minnesota in 2008 supervised by Professor Lanny D. Schmidt. From 2008 to 2009, Paul worked as a senior research engineer for the Dow Chemical Company within Core R&D Reaction Engineering in Midland, MI and the Hydrocarbons & Energy Department in Freeport, TX. In 2009, he joined the University of Massachusetts, Amherst, Department of Chemical Engineering as an assistant professor. As of 2014, he is the Lanny & Charlotte Schmidt Professor and MacArthur Fellow at the University of Minnesota in the Department of Chemical Engineering and Materials Science. His work has been highlighted with the NSF CAREER award, the DOE Early Career Award, the Camille Dreyfus Teacher-Scholar award, and the AIChE CRE Young Investigator award. His published patent applications serve as the scientific foundation of three startup companies: Sironix Renewables, Activated Research Company, and enVerde, LLC.

References

[1] M.A. Ardagh, O. Abdelrahman, P.J. Dauenhauer, "Principles of Dynamic Heterogeneous Catalysis: Surface Resonance and Turnover Frequency Response" *ACS Catalysis*, 2019, 9(8), 6929-6937

[2] M. Shetty, et al. "The Catalytic Mechanics of Dynamic Surfaces: Stimulating Methods for Promoting Catalytic Resonance," *ACS Catalysis*, 2020, DOI: 10.1021/acscatal.0c03336