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Selective Hydrogenation of Furfural in a Proton Exchange Membrane Reactor Using Hybrid Pd/Pd Black on Alumina


S. Carl


K. Waldrop


P. Pintauro


L. T. Thompson


W. A. Tarpeh

Invited for this month's cover picture are the groups of Dr. Peter Pintauro (Vanderbilt University, Tennessee, USA), Dr. Levi Thompson (University of Delaware, Delaware, USA), and Dr. William Tarpeh (Stanford University, California, USA). The cover picture shows the controlled variation of furfural hydrogenation product speciation based on varying cathode formulations of hybrid Pd black and Pd on alumina support. Read the full text of the article at 10.1002/celc.201901314.

How did the collaboration on this project start?

Dr. Pintauro and Dr. Thompson began this collaboration based on the Pintauro group's experience with proton exchange membrane electrode assemblies and the Thompson group's observation of enhanced hydrogenation with bifunctional tungsten carbide catalysts. Dr. Tarpeh joined the collaboration as a postdoctoral fellow and extended it as a junior faculty member by contributing expertise on electrocatalysis to characterize selectivity and activity of hybrid cathodes for furfural hydrogenation. Together, the groups have elucidated performance and mechanisms of the hybrid Pd black/Pd on alumina cathodes while demonstrating controlled hydrogenation of furfural.

What future opportunities do you see?

We chose a model biomass compound (furfural) to determine the potential of Pd/Pd black hybrid electrocatalysts to control hydrogenation rates and selectivities for other compounds; thus, we anticipate applications to other industrial hydrogenation reactions for the production of fine chemicals. After demonstrating the enhanced capability of one hybrid electrocatalyst, we also intend to explore other bifunctional catalysts to reduce emissions of other industrial and environmental reactions, including fertilizer production, nitrate reduction, and electrochemical reduction of organic pollutants in water.

Who designed the cover?

Sarah Carl, the first author of the paper and a graduate student alumna from University of Michigan, designed the cover. Since the completion of experiments in the paper, Sarah has graduated and is now a staff engineer at an environmental consulting company.

What other topics are you working on at the moment?

The Tarpeh lab focuses on selective aqueous separations using electrocatalysis, adsorbents, and membranes. We aim to valorise wastewaters by extracting valuable products from them, including fertilizers, disinfectants, and commodity chemicals. At the molecular scale, we elucidate mechanisms of reaction and transport during electrochemical ammonia stripping, sulphide oxidation, and valorisation of desalination brine. By replacing chemical inputs with electrocatalysis, we intensify processes that enable distributed manufacturing and water purification to advance our vision of a zero-emission future in which wastewaters are mined for maximal value.