

## **Strategies for the Production and Conversion of Bioprivileged Molecules from Biomass**

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**Abstract**      **Seminar on March 20, 2018 at 11:00 am in 2004 Black**

Recent progress in metabolic engineering has given access to new microorganisms able to convert carbohydrates and waste lignin into platform chemicals that can be further diversified using chemical catalysts. Among the various platform intermediates investigated, muconic acid holds high promise as an intermediate for the production of both commodity chemicals and novel species that are not accessible from petroleum. However, to develop competitive processes, it is crucial to streamline the fermentation and chemical diversification steps, and design new catalysts that address the structural complexity of multifunctional bio-based chemicals.

Attempts to integrate fermentation and thermocatalysis have failed due to the presence of biogenic impurities that poison conventional heterogeneous catalysts. To overcome this barrier, our group explores new electrochemical routes where Pt-group catalysts are replaced by robust base metal electrodes. This approach is particularly interesting for hydrogenation reactions as hydrogen is produced in situ from the aqueous fermentation broth and under ambient conditions. In the case of muconic acid, electrohydrogenation gives access to adipic acid, a commodity monomer used for the production of Nylon-6,6, and 3-hexenedioic acid, an unsaturated analog that finds applications in the production of bio-advantaged polyamides.

Our kinetic and mechanistic investigations of the (electro)hydrogenation reactions taking place on carbon-supported metal nanoparticles revealed unexpected differences in selectivity depending on particle size and graphitic character of the carbon scaffold. To study these phenomena in more details, we decreased the level of complexity of disordered nanocarbon supports and decoupled chemical and electronic effects. We show that structural defects alter the work function of carbon supports, hereby inducing a charge redistribution at the metal-carbon interface. This charge transfer enhances both the activity and selectivity of metal atoms near the interface. This discovery offers exiting perspectives for targeting a specific bond within complex multifunctional chemical, hence increasing selectivity for biomass conversion reactions.

: Jean-Philippe Tessonier is an Assistant Professor in the Department of Chemical and Biological Engineering at Iowa State University. He earned his Ph.D. degree from the University of Strasbourg, France, in 2005. He then joined the Fritz Haber Institute of the Max Planck Society in Germany as a post-doctoral researcher and was promoted to project leader in 2008 to coordinate the departmental activities on nanocarbons. He moved to the University of Delaware as a visiting researcher in the Department of Chemical and Biomolecular Engineering in 2011, and to Iowa State University in 2012. He is a faculty member of the NSF Engineering Research Center for Biorenewable Chemicals (CBiRC), as well as a member of the Bioeconomy Institute (BEI) and an associate scientist of the U.S. Department of Energy Ames Laboratory. Trained as a chemist and materials scientist, he combines synthesis and advanced characterization to design catalysts that address key challenges in biomass conversion and green chemistry. Prof. Tessonier has published over 70 peer-reviewed publications and is a co-inventor on 9 patents.

***This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.***

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