

- ▶ Wednesday, September 9, 2009
- ▶ 11:00 A.M.
- ▶ 366 Colburn Laboratory

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Professor Jones began his research on catalysis and materials while completing his undergraduate studies in chemical engineering at the University of Michigan and obtained MS and PhD degrees in chemical engineering from Caltech. He joined Georgia Tech as assistant professor of chemical engineering in 2000, and in 2005 was named the J. Carl & Sheila Pirkle Faculty Fellow in the School of Chemical & Biomolecular Engineering. Professor Jones is the recipient of numerous awards: Innovation Recognition Award, NSF (CAREER Award), Oak Ridge Associated Universities (Ralph Powe Award), Sigma Xi (Young Faculty Award), DuPont (Young Professor Grant) and Shell (Faculty Career Initiation Award), CETL/BP Junior Faculty Teaching Excellence Award. He was named a Hesburgh Teaching Fellow at Georgia Tech in 2005 and promoted to professor in 2008.

“Identifying the True Catalyst in High Temperature Pd Catalyzed Heck and Suzuki Reactions”

Heck and Suzuki reactions are critically important in pharmaceutical synthesis, often being the methods of choice for creating C-C bonds involving aryl carbons. Every major pharmaceutical manufacturer has developed substantial in-house expertise in “the art of Heck and Suzuki coupling catalysis.” These reactions are fascinating from a catalysis science perspective, as nearly every form of palladium has been shown to be a “catalyst” for some, but not all, Heck and Suzuki reactions. Is every form of palladium truly active, or is there a common catalytic species generated *in situ*?

Often, the molecule or material that a chemist or engineer places in a flask or a reactor as the “catalyst” is in fact a *precatalyst* that restructures under reaction conditions to form the truly catalytic species. In some cases, most of the precatalyst remains unchanged, while traces (sometimes <<<1%) of precatalyst transform into the active species in the reactor. How can we determine what the real catalytic species is? Here I will describe our use of parallel studies on homogeneous and supported Pd(II) organometallic precatalysts in Heck and Suzuki reactions. Via combination of catalytic, kinetic and new poisoning studies that we have introduced, we have developed a protocol for assessing the nature of the true catalyst in Pd-catalyzed Heck and Suzuki coupling reactions. Using our approach, we have been able to show that many catalysts previously described as heterogeneous actually leach active, homogeneous catalysts into solution. Indeed, a thorough literature review supports a unified model for high temperature Heck and Suzuki catalysis.¹⁻²

¹“On the Nature of the Catalytic Species in Palladium Catalyzed Heck and Suzuki Couplings – Homogeneous or Heterogeneous Catalysis, a Critical Review,” N. T. S. Phan, M. Van Der Sluys, C. W. Jones, *Adv. Synth. Catal.*, **2006**, 348, 609-679.

²“A unifying mechanism for all high-temperature Heck reactions. The role of palladium colloids and anionic species,” J. G. de Vries, *Dalton Trans.*, **2006**, 421-429.