

CHEMICAL ENGINEERING

SEMINAR SERIES



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Methane steam reforming: Using external electric fields to enhance the catalytic performance of Ni

ABSTRACT: According to the Annual Energy Outlook for 2014, natural gas production in the US has been on the rise since 2005 and is projected to continue rising through 2040. In order to make the most of this abundant natural resource and at the same time reduce emissions of harmful greenhouse gases it is imperative that we fully understand the catalytic reactions which are used in methane processing – particularly in the case of methane steam reforming (MSR). The current infrastructure, which is set up for the transportation of natural gas, oil, and gasoline, presents a serious economic disadvantage for the use of hydrogen gas as an alternative fuel source such as in hydrogen fuel cell-based cars.

Additionally, MSR is one of main reactions that occur on the Ni-based anode for direct methane solid oxide fuel cells (SOFCs). MSR is our reaction of interest because the conversion of methane to syngas greatly affects the charge-transfer chemistry and consequently influences the SOFCs' performance. However, there are two significant issues facing MSR: (i) Coke formation; (ii) High temperatures of above 900 K. To address these issues, we are interested in the effect of an external electric field on this process. A large external electric field can rearrange the potential energy states of molecular orbitals, alter adsorbate-surface interactions, and directly change the overall electrocatalytic activity of Ni-based catalysts. In this presentation, we investigate the effects of an electric field on the MSR reaction both computationally and experimentally with the expectation that we would be able to reduce the formation of coke and reduce the MSR reaction temperature significantly while maintaining overall conversion. This information can also be used to design new electrochemical systems and to enhance the catalytic performance of Ni-based steam reforming operations.

RECEPTION 3:30 • LECTURE 4:00 – 5:00
PHYSICS ASTRONOMY BLDG. (PAA) A118



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BIOGRAPHY: Jean-Sabin McEwen earned his B. Sc. in Physics at McGill University, Canada. He then went on to earn his M. Sc. and his Ph.D. in Physics at Dalhousie University, Canada. He spent about two years as a postdoctoral fellow in Belgium at the Université Libre de Bruxelles and three years in Belgium at the F.R.S.-FNRS. He went on to obtain a position as research assistant professor at the University of Notre Dame for two years. He is now an assistant professor at Washington State University. He has published 36 peer-reviewed publications over the span of his career.