PURDUE UNIVERSITY

Integrated Computational Materials Engineering of Multiphase Steels

Louis G. Hector, Jr., Ph.D.
General Motors R&D Center
Warren, MI 48090-9055

Thursday September 7, 2017, 11:00 am
KS Fu room, Potter 234

"The story of humanity…would not have been possible without the expanding and increasingly intricate and complex use of materials." So begins Vaclav Smil's *Making the Modern World*.[1] The same human ingenuity that over the centuries took materials from the earth to produce clothing, shelter, tools, modes transportation, and European Cathedrals, is now creating new computational and experimental methods for investigating multi-length scale engineering material behavior. Many of these methods are being incorporated into a system for materials discovery known as Integrated Computational Materials Engineering, or ICME, which is aimed at unifying multi-scale materials modeling and experimentation with manufacturing and product design. Multiphase advanced high strength steels (AHSS), which are finding increased use in automotive body structures, are fertile ground for ICME since they exhibit fascinating material behaviors such as deformation mode and strain path dependent phase transformation, propagative instabilities, and strain rate sensitivity of flow properties. However, prediction of behavior at engineering length scales based upon the multi-scale physical, chemical, and mechanical phenomena in these complex materials is a formidable challenge for ICME, in part, because of the voluminous amount of experimental data required for calibration and validation of computer models. This presentation will focus on applications of ICME to the discovery of new AHSS through manipulation of material microstructures[2]. In the first application, ICME is applied to predict new dual phase steels with improved formability and fracture resistance. In the second application, ICME is use to investigate multiphase steels that exhibit phase transformation. The connection between ICME and product engineering will be emphasized.

Biosketch: Lou Hector, Jr. is a GM Technical Fellow in the Chemical and Materials Systems Lab at the General Motors R&D Labs in Warren, Michigan where he conducts research in engineering materials such as advanced high strength steels, non-ferrous alloys (e.g. magnesium and aluminum), Li-ion batteries, shape memory alloys, biomimetic materials, complex fabrics, catalytic materials, plastics, composites, and hydrogen storage materials. In 1981, Lou earned his B.S. (Honors) degree in Physics from Loyola University, Chicago, and then completed his Ph.D. in Mechanical Engineering from Northwestern University in 1986. He joined GM R&D in January 2001 after nearly 14 years at Alcoa Technical Center. Under his leadership as PI, a recently completed DOE Project on Integrated Computational Materials Engineering (ICME) of Gen 3 advanced high strength steels received multiple awards and is now a template for future ICME projects. Since graduating from Northwestern University, Lou has co-authored over 200 publications, participated as Co-PI in 8-NSF GOALI grants, and holds 11-U.S. patents. His published research has received more than 6400 citations. Lou was awarded the 2014 Brimacombe Medal from The Minerals, Metals & Materials Society (TMS). He also received three-John M. Campbell Innovation Awards for contributions to fundamental materials science and engineering, the Charles L. McCuen Innovation Award for advancements in Mg forming, and multiple USAMP special recognition awards.

---

[1] V. Smil. *Making the Modern World*. John Wiley & Sons, Ltd., United Kingdom, 2014.
[2] This presentation is based upon work supported by the Department of Energy under Cooperative Agreement Number DE-EE0005976 with United States Automotive Materials Partnership LLC (USAMP).

For more information contact Pablo Zavattieri (zavattie@purdue.edu) or Srinivasan Chandrasekar (chandy@purdue.edu)