SAND2013-9413C

Solar Thermochemical Water Splitting: Advances in Materials and Methods

A.H. McDaniel* and M.D. Allendorf, Sandia National Labs, Livermore, CA, USA; I. Ermanoski, A Ambrosini, E.N. Coker and J.E. Miller, Sandia National Labs, Albuquerque, NM, USA; W.C. Chueh, Stanford University, Palo Alto, CA, USA; R. O'Hayre and J. Tong, Colorado School of Mines, CO, USA

It is estimated that population growth and continued industrialization of developing countries will double global energy consumption by 2035. And in so doing, increase the anthropogenic carbon content in the atmosphere furthering the deleterious effects of climate change. Developing technologies that covert solar energy into simple chemical fuels is therefore a societal imperative. This talk will describe our efforts to directly harness highly-concentrated thermal energy from the sun to produce hydrogen fuel via a two-step thermochemical water-splitting reaction. Critical to the development of such a process are materials specifically designed and optimized for efficient operation in extreme thermal environments. This talk will focus on the use of perovskite oxides and our efforts to derive key relationships between composition and functionality. In addition, there is no clear answer to which of the many materials proposed for this use (e.g., ferrite or ceria) will ultimately lead to the highest overall process efficiency. Therefore, key design principles for achieving optimal solar-to-fuel conversion efficiency will be reviewed and create a framework for discussing the desired properties of materials within the context of an advanced particle-bed receiver reactor concept.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.