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Development of advanced biofuels and biomass conversion technologies at the Joint BioEnergy Institute

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Today, carbon-rich fossil fuels, primarily oil, coal and natural gas, provide 85% of the energy consumed in the United States. Fossil fuel use increases CO₂ emissions, increasing the concentration of greenhouse gases and raising the risk of global warming. The high energy content of liquid hydrocarbon fuels makes them the preferred energy source for all modes of transportation. In the US alone, transportation consumes around 13.8 million barrels of oil per day and generates over 0.5 gigatons of carbon per year. This has spurred intense research into alternative, non-fossil energy sources. The DOE-funded Joint BioEnergy Institute (JBEI) is a partnership between seven leading research institutions (Lawrence Berkeley Lab, Sandia Labs, Lawrence Livermore Lab, Pacific Northwest National Lab, UC-Berkeley, UC-Davis, and the Carnegie Institute for Science) that is focused on the production of infrastructure compatible biofuels derived from non-food lignocellulosic biomass. Biomass is a renewable resource that is potentially carbon-neutral. Plant-derived biomass contains cellulose, which is more difficult to convert to sugars. The development of cost-effective and energy-efficient processes to transform cellulose and hemicellulose in biomass into fuels is hampered by significant roadblocks, including the lack of specifically developed energy crops, the difficulty in separating biomass components, low activity of enzymes used to hydrolyze polysaccharides, and the inhibitory effect of fuels and processing byproducts on the organisms responsible for producing fuels from monomeric sugars. This presentation will highlight the research efforts underway at JBEI to overcome these obstacles, with a particular focus on the development of an ionic liquid pretreatment technology for the efficient production of monomeric sugars from biomass.

Biography

Dr. Simmons joined Sandia National Laboratories in 2001 as a Senior Member of the Technical Staff, serving as a member of the Materials Chemistry Department. He participated on and led a variety of projects, including the development of cleavable surfactants, enzyme engineering for biofuel cells, microfluidics, and the synthesis of silicate nanomaterials. He was promoted to Manager of the Energy Systems Department in 2006. The primary focus of the department was the development of novel materials-based solutions to meet the nation's growing energy demands. He is one of the principal co-investigators of the Joint BioEnergy Institute (JBEI, www.jbei.org), a \$259M, ten-year DOE funded project tasked with the development and realization of next-generation biofuels produced from non-food crops. He is currently serving as the Chief Science and Technology Officer and Vice-President of the Deconstruction Division at JBEI, where he leads a team of 43 researchers working on advanced methods of liberating fermentable sugars and lignin from lignocellulosic biomass. He is also the Senior Manager of Biofuels and Biomaterials Science and Technology at Sandia, where he also serves as the Biomass Program Manager. He has over 220 publications, book chapters, and patents. His work has been featured in the New York Times, the Wall Street Journal, the San Francisco Chronicle, and the KQED televised science program Quest.

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