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Current fundamental science challenges in low temperature plasma science that impact energy security and international competitiveness

GREG HEBNER, Sandia National Laboratories

Products and consumer goods that utilize low temperature plasmas at some point in their creation touch and enrich our lives on almost a continuous basis. Examples are many but include the tremendous advances in microelectronics and the pervasive nature of the internet, advanced material coatings that increase the strength and reliability of products from turbine engines to potato chip bags, and the recent national emphasis on energy efficient lighting and compact fluorescent bulbs. Each of these products owes their contributions to energy security and international competitiveness to fundamental research investments. However, it would be a mistake to believe that the great commercial success of these products implies a robust understanding of the complicated interactions inherent in plasma systems. Rather, current development of the next generation of low temperature plasma enabled products and processes is clearly exposing a new set of exciting scientific challenges that require leaps in fundamental understanding and interdisciplinary research teams. Emerging applications such as liquid-plasma systems to improve water quality and remediate hazardous chemicals, plasma-assisted combustion to increase energy efficiency and reduce emissions, and medical applications promise to improve our lives and the environment only if difficult science questions are solved. This talk will take a brief look back at the role of low temperature plasma science in enabling entirely new markets and then survey the next generation of emerging plasma applications. The emphasis will be on describing the key science questions and the opportunities for scientific cross cutting collaborations that underscore the need for increased outreach on the part of the plasma science community to improve visibility at the federal program level. This work is supported by the DOE, Office of Science for Fusion Energy Sciences, and Sandia National Laboratories, a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000