Controlling Plasma-Surface Interactions for Liquid, Biological and Environmental Systems

ABSTRACT

Plasma surface interactions are indispensable in materials processing over a large range of applications and a wide range of pressures. Tremendous progress has been made in optimizing reactive fluxes in low pressure plasmas for microelectronics fabrication. At the other extreme is the use of atmospheric pressure plasmas for modification and functionalization of organic materials and liquids, and for chemical processing. Those organic materials now include living tissue – the discipline of plasma medicine. Plasma modification of metals, semiconductors and organic polymers typically occurs only on the top surface. Plasma treatment of liquids and living tissue is intended to influence processes well below the surface. Using results from computational investigations, we will discuss the common themes in this broad range of low temperature plasma-surface interactions. We will first discuss methods to control the gas phase plasma production of reactive species, and then extend those methods to controlling reactive plasma produced fluxes to surfaces. Examples will be taken from plasma activation of thin liquid films, liquid aerosols and cellular tissue; and plasma propagation through packed-bed-reactors for chemical conversion.

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Dr. Mark J. Kushner received the BS and BA from the University of California-Los Angeles, and the MS and Ph.D. in Applied Physics from the California Institute of Technology. He served on the technical staffs of Sandia National Laboratory, Lawrence Livermore National Laboratory and Spectra Technology before joining the University of Illinois in 1986 where he was the Founder Professor of Engineering. In January 2005, Dr. Kushner joined Iowa State University as Dean of Engineering where he established the Engineering Policy and Leadership Institute. Prof. Kushner joined the University of Michigan as founding director of the Michigan Institute for Plasma Science and Engineering and George I. Haddad Collegiate Professor in September 2008. Prof. Kushner's research area is the fundamentals and applications of low temperature plasmas on which he has published more than 330 journal articles. He is a Fellow of several societies and has received several awards including the APS Allis Prize. He is a member of the US National Academy of Engineering.