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Increasing understanding of the plasma-surface boundary layer and surface chemistry using optical sum frequency generation diagnostic tools

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Understanding and controlling the properties of materials at the plasma surface boundary is fundamental to applications such as microelectronic feature definition, surface cleaning, and surface treatment. While traditional surface science diagnostic tools have been used to increase fundamental understanding of this critical boundary layer, their interpretation is sometimes clouded by the need to remove the sample from the plasma environment to analyze it. Infrared-visible sum frequency (IVSF) spectroscopy is a molecularly specific diagnostic that can be used to follow molecular interactions and plasma initiated chemistry at the plasma-surface boundary layer in quasi real-time. This talk will first provide an overview of surface sum-frequency generation spectroscopy and its applications to plasma-surface interactions. We then present an in-situ characterization of octadecyltrimethoxysilane monolayers and other common industrial polymers on quartz in the presence of a high pressure oxygen plasma. These test systems will be used to demonstrate the unique advantages and limitations of IVSF as an in-situ surface diagnostic in plasma systems. This work was supported by the Department of Energy Office of Science, Division of Materials Science, and Sandia National Laboratories, 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.