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Plasma-surface interaction: in situ and real time studies during plasma processing of materials

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In this talk I will review our approach to study in situ and in real time the surface kinetic processes occurring during plasma deposition and etching. We have chosen for a photon-in-photon-out approach and have developed novel ultra sensitive techniques to unravel the radical- and ion-surface interactions. I will discuss specifically the techniques of evanescent wave cavity ring down spectroscopy, second harmonic generation and spectroscopic ellipsometry which in combination with gas phase diagnostics such as cavity ring down spectroscopy and threshold ionization mass spectrometry provide an unique possibility to understand the surface kinetic processes. These studies enable the manipulation of the plasma properties to obtain specific material applications. Examples include the understanding of the plasma oxidation of ultra-thin aluminum films for magnetic tunnel junctions, the deposition of dense barrier layers for plastic electronics applications and the high rate deposition of surface and bulk passivating films for multi-crystalline solar cells.