

VUV INDUCED HOLE AND PHOTOEMISSION CURRENTS IN PLASMA CHARGED GATE DIELECTRICS

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Plasmas are used extensively used in the semiconductor industry for thin film deposition, ashing, and etching of materials. The plasma is a harsh environment for dielectrics since it constitutes high-energy electrons and ions that bombard the surface of the material. This leads to charging of the wafer surface, which induces tunneling currents in the gate oxide and other dielectrics causing them to deteriorate. Consequently, the reliability of the end product is conversely affected. The three sources of oxide damage are, i) plasma non-uniformity, ii) topography dependent charging, also known as electron shading, and, iii) radiation induced damage. Of these mechanisms, plasma non-uniformity is not a serious concern anymore owing to higher quality plasma tools and a deeper understanding of plasma physics in general. One of the often cited reason for the reduction in plasma induced charging damage is the drastically increased tolerance of stress current by thinner gate oxides. However, electron shading and radiation induced damage related issues have continued to confound scientists and engineers. This has been primarily due to the lack of competent diagnostics and measurement techniques that can systematically categorize every form of damage simultaneously in a plasma environment. In particular, damage caused by VUV (vacuum ultraviolet) radiation in a plasma environment to the semiconductor gate oxide is drawing special attention with the increased focus on high-k dielectrics as a replacement for the traditional silicon oxide. Consequently by charging oxide layers of different thicknesses in a RF plasma and exposing them to different VUV energies, a wealth of information about charge transport and increased conductivity in the dielectric can be obtained. This presentation will discuss some preliminary results from experiments carried out at the UW-SRC Al-Seya and 4m-NIM port. In addition, a brief summary of future work will be presented.