UNH Materials Science Seminar

11:00-12:00, Thursday, March 31, 2005
DeMeritt Hall 209B, University of New Hampshire

Detection of etch and ash damage to nanoporous methysilsequioxane, low k dielectric, by electrostatic force microscopy with nanoscale resolution

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Copper and insulators with low dielectric constants (low k dielectrics) have replaced aluminum/ SiO_2 interconnections in high performance integrated circuits to reduce circuit RC delays. Porous methysilsesquioxane (MSQ) is currently being integrated into 130 nm damascene interconnect structures as a low k dielectric. The $(RSiO_{1.5})n$ structure of MSQ consists of ladders, polycyclic groups, and linear chains. The methyl groups make the film hydrophobic and help to form nanometer size pores that reduce the film density and dielectric constant. The O_2 plasma in ash processes causes carbon depletion which changes the hydrophobic film to hydrophilic. This can result in a large increase of dielectric constant if the film absorbs water. The EFM technique is a sensitive method to detect nanoscale dielectric constant variation, and is able to detect the damage to the MSQ induced by pattern processes such as plasma ash and reactive ion etch. This presentation will focus on the results obtained from MSQ based low k dielectrics (k= 2.2). EFM fundamentals, sample preparation, qualitative and quantitative measurement, resolution, calibration methods and modeling will be described.