

Abstract Submitted  
for the MAR15 Meeting of  
The American Physical Society

**Low field, non-destructive investigation of the effect of moisture on the reliability of low-k dielectrics via dielectric relaxation**  
ROBERT LAIBOWITZ, ARCHANA RAJA, Columbia University, ERIC LINGER, THOMAS SHAW, IBM T. J. Watson Research Center — Assessing the reliability of low dielectric constant ( $<3.9$ ) materials is an important problem for the scalability of integrated circuits to reduced dimensions. The decrease in capacitance ensures lower power consumption and shorter RC delays. The materials are typically nanoporous and are composed of Si, C, O and H. We present a non-destructive, low field investigation of the effect of moisture on Back End of Line integrated circuit capacitors as used in industry. The low-k dielectric layers are around 40nm thick with a  $k=2.5$ . Through the measurement of dielectric losses as a function of temperature and applied frequency, we assign two relaxation modes of water in the pores of the dielectric, having thermal activation energies of 0.30 and 0.56eV. Study of dielectric loss as a function of humidification yields a direct correlation to the time dependent dielectric breakdown, wherein increased water incursion into the low k dielectric reduces the lifetime of the device.

Archana Raja  
Columbia University

Date submitted: 14 Nov 2014

Electronic form version 1.4