

COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

E E S e m i n a r

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“Reliability Enhancement by Suppression of Nano-Dendritic Defects in Metal-Insulator-Metal Capacitors in Integrated Circuits”

Friday October 10, 2008

Room 225 REND, ISU Pocatello Campus

1:00 – 1:50 p.m.

ABSTRACT: Mixed-signal automotive integrated circuits require high voltage capability, high temperature operation, high reliability (0 ppm) as well as low cost. One of the key components of a mixed-signal device is integrated linear capacitors. Metal-insulator-metal (MIM) capacitors with silicon nitride (Si₃N₄) as the dielectric are integrated into the AlCu backend of ON's 80V mixed-signal process. Although sufficient for many other applications, a single-digital ppm failure rate of MIM capacitors was not acceptable for automotive products.

A comprehensive failure analysis procedure nondestructively revealed for the first time the TiN nano-dendrite defect growing from a 10-nm-diameter aluminum whisker. This failure origin clearly suggested the importance of optimizing the bottom aluminum process module to prevent whisker occurrence. The enabled process has remarkably reduced reliability risks by suppressing the defectivity by a factor of 40. This reduced product wear-out returns from dozens-of-ppm to sub-ppm levels.