TiZrN as a Copper Barrier for 0.13 and .09uM Technology Nodes

Dean Denning, Iraj Shahvandi, Lynn Svedberg, Chris Prindle
Motorola, Inc., 3501 Ed Bluestein Blvd, Austin, TX 78721, USA
512-933-5205 (ph), 512-933-6438 (fax), e-mail: rxda40@email.sps.mot.com

Abstract:

PVD TiZrN has been investigated as a potential barrier material for current and future copper metallization. A process was developed that provided stable film characteristics. Several techniques have been performed to characterize TiZrN as a barrier material. Patterned wafers showed the film provided adequate step coverage and barrier performance. Electrical measurements were made on 0.13uM and 0.09uM node dual inlaid patterned wafers and equivalent to better results were seen as compared to the traditional Ta based barrier.

Introduction and motivation:

Tantalum has been used as the base barrier metal for copper technology for the first generations of inlaid copper technology. It offers excellent barrier properties and can be sputter deposited in very thin continuous films. TiN has been investigated in the past for copper barrier application, but was shown to have poor step coverage as compared to Ta/TaN due to its higher sticking coefficient. Two drawbacks to Ta are it is not an abundant element and the supply is limited and the raw material cost is much higher than Ti.

A Titanium/5% Zr target material was installed in an advanced barrier/seed sputter deposition system and directly compared to PVD Ta.

Several techniques were used to characterize the barrier material including FIB, SEM, SIMs, TEM, AFM, 4PP, stress, scanning laser particle measurement. These techniques along with electrical characterization and integration aspects of 0.13uM and 0.09uM node interconnect features will be presented.

Conclusions:

PVD TiZrN barrier has been successfully integrated into 0.13uM and 0.09uM technology nodes and shown to perform electrically equivalent or better than the Ta based barrier.

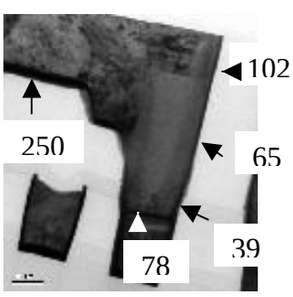

Figure 1. TEM Step Coverage of 0.09uM DI feature. AR=5:1, 0.26uM pitch

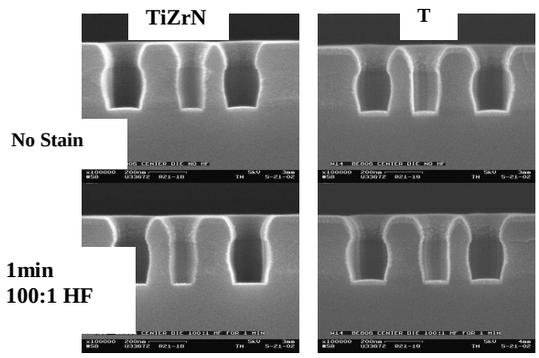

Figure 2. Effect of HF exposure No etching of the dielectric was seen at a 1 min HF which is an indication that the barrier is continuous.

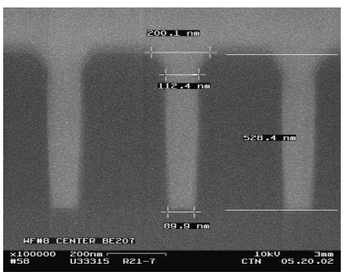

Figure 3. Integration with 7:1 AR 90nM vias