Abstract Submitted
for the 4CF12 Meeting of
The American Physical Society

Wet Nano-Bonding of Silica-to-Si and Silica-to-Silica below 200° C by H2O catalysis and a 2-D precursor phase: TMAFM, Hydroaffinity and Surface Free Energy Analysis ROSS BENNETT-KENNETT, SHAWN WHALEY, NICOLE HERBOTS, CLARIZZA WATSON, ROBERT CULBERTSON, PETER REZ, ASHLEE MURPHY, SAM FARMER, DAVID SELL, BRETT HUGHES, AJJU ACHARYA, Arizona State University — Hydroxylated silica about 2.1 ± 0.1 nm thick are nucleated on OH(1x1)Si(100) as precursor phase to cross-bond directly silica to Si, and silica to silica using planarization via extended atomic terraces, T≤ 200°C, an H2O/O2 ambient, and p ≥ 1 atm. This method,"Wet Nano-Bonding^{TM}," relies on the Herbots-Atluri process [1] to nucleate precursor phases to bond via direct hydroxylated silica molecular cross-bridges two surfaces brought into contact at the nano-scale. Ordered Si2(OH)4 β-cristobalite precursor phases exhibit atomic terraces that extend to >20 nm, in contrast to the 2 nm width in "as received" Si(100) wafers. β-cristobalite nano-phases can desorb at low temperatures (T </ ∼ 200° C) [3]. These ordered oxides can promote the growth of flatter, smoother, better controlled oxides at low temperatures in ambient air. When put into close contact at T≥ 200° C with oxygen-deficient phases of SiOx used in microelectronics, they can consistently nucleate a cross-bridging between the two substrates, or "nano-bonding" inter-phase [4] between various combinations Si and silica provided an H2O/O2 ambient catalyzes low temperature oxidation and nano-contacting is achieved via pressurization in the nano-bonding chamber.

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Date submitted: 25 Sep 2012 Electronic form version 1.4