Abstract Submitted
for the 4CF15 Meeting of
The American Physical Society

Measuring Surface Energy and Reactivity of SiO2 Using the Van Oss Theory and Three Liquid Contact Angle Analysis ASHLEY A. MASCARENO, ALEX L. BRIMHALL, ENDER W. DAVIS, Arizona State University Dpt Physics, MATTHEW T. BADE, Brophy College Preparatory, NITHIN KANNAN, ABIJITH KRISHNAN, Arizona State University/ BASIS Scottsdale HS, DR. NICOLE HERBOTS, Arizona State University Dpt Physics, CLARIZZA F. WATSON, SiO2 Nanotech LLC, SIO2 NANOTECH LLC TEAM — Surface energies γ^T can characterize reactivity for Wet NanoBonding^{TM} of Si(100) and SiO_2, a 200°C process where surfaces cross-bond. The Van Oss theory models γ^T via 3 interaction energies, γ^{LW} for Lifshitz-Van der Waals (LW) interactions, γ^- for electron acceptors and γ^+ for donors, with $\gamma^T = \gamma^{LW} + 2\sqrt{\gamma^+\gamma^-}$. To calculate γ^{LW}, γ^+, and γ^-, contact angles for 3 different liquids are measured in a Class 100 hood. For precision, 4-8 droplets are used instead of 1. Three SiO_2/Si(100) structures are analyzed: amorphous thermal a-SiO_2, HF-etched thermal a-SiO_2, and ordered 2 nm-thick c-SiO_2 produced by the Herbots-Atluri (H-A) process. In thermal a-SiO_2 surfaces, $\gamma^T = 45 \pm 2\frac{mJ}{m^2}$, while in more defective HF-etched a-SiO_2, $\gamma^T = 57.5 + / - 2\frac{mJ}{m^2}$. Because HF-etching yields a γ^T closer to γ^T of H_2O ($72 \pm 0.4\frac{mJ}{m^2}$), HF-etching makes the surface more hydrophilic. In contrast, in hydrophobic, ordered 2nm-thick H-A c-SiO_2, $\gamma^T = 37.3 \pm 2\frac{mJ}{m^2}$. In ordered c-$SiO_2$, $\gamma^{LW} = .98\gamma^T$. However, for etched a-$SiO_2$, $\gamma^{LW} = .65\gamma^T$ and $\gamma^- = .48\gamma^T$.

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Date submitted: 28 Aug 2015 Electronic form version 1.4