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Optimizing Wet NanoBonding^{TM} using Three Liquid Contact Angle Analysis of Surface Energy and Reactivity ENDER W. DAVIS, Arizona State University, NICOLE HERBOTS, ROBERT J. CULBERTSON, ALEX L. BRIMHALL, ASHLEY A. MASCARENO, Arizona State University Dpt. of Physics, CLARIZZA F. WATSON, SiO2 NanoTech LLC, ABIJITH KRISHNAN, NITHIN KANNAN, Arizona State University Dpt. of Physics/BASIS Scottsdale HS, MATTHEW T. BADE, Arizona State University Dpt. of Physics/Brophy College Prep, SIO2 NANOTECH COLLABORATION — Silicon-based surfaces, such as thermally-grown amorphous a-SiO_2 and Si(100), are hermetically bonded using wet NanoBonding^{TM}. Initial surfaces are modified to favor electron exchange and cross-bonding. a-SiO_2 is etched with hydrofluoric acid (HF), while β-cSiO_2 is grown on Si(100). Next, both are NanoBonded under steam pressurization. NanoBonding can bond medical, marine, and air sensors to their electronics, and be used in night vision goggles and solar cells. To optimize cross-bonding, surface energy γ^T is studied via 3 liquid contact angle analysis (3LCAA) and the Van Oss theory. This models γ^T via 3 components: γ^{LW} for dipole interactions, γ^+ for electron donors, and γ^- for acceptors. 3LCAA extracts contact angles from 3 liquids with known surface energies: water, glycerin, and α-bromonaphthalene. We use several droplets of each liquid on the surface to improve accuracy. γ^+ accounts for little to none of the surface energy of all surfaces, but the annealing in Wet NanoBonding significantly increases γ^+ in β-cSiO_2. Conversely, HF etching significantly increases γ^- for a-SiO_2. This donor/acceptor imbalance enhances reactivity and NanoBonding between the surfaces.

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