Abstract Submitted
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GaAs-Si Tandem Solar Cells Formed At T<500K by Nano-Bonding via Surface Energy Engineering S. JANDHYALA, P. PENMATCHA, A. GURIJALA, A. CHOW, S. KHANNA, S. RAM, M. BERTRAM, C. CORNEJO, T. DIAZ, W. PENG, T. BALASOORIYA, N. GURIJALA, M. SAHAL, R. J. CULBERTSON, Arizona State U., K. L. KAVANAGH, Simon Fraser U., N. HERBOTS, Arizona State U. — The theoretical Photo-Voltaic Efficiency (PVE) of GaAs/Si tandem solar cells (SC) is 44%, but practically is only 33% because current technology uses hetero-epitaxy or Direct Wafer Bonding at T >700 K. Hence Nano-Bonding (NB) at T <500K is used here instead to planarize GaAs and Si at the nano-, micro- and macro-scale via far-from-equilibrium surface phases via Surface Energy Engineering (SEE), then 'nano-contacts' GaAs to Si via light mechanical compression 0- 70 kPa at T <500 K to nano-bond. SEE reverses initial hydro-affinity (HA) of GaAs from hydrophobic to hydrophilic, and vice-versa for Si. HA and Surface Energy SE are measured by Three Liquid Contact Angle Analysis. High Resolution Ion Beam Analysis (HR-IBA to yield absolute Oxygen coverage. X-Ray Photoelectron Spectroscopy yields surface stoichiometry. The SE of GaAs increases via SEE from 30.41 mJ/m^2 to 602 mJ/m^2, while IBA detects a 50% decrease in Oxygen coverage from 7 ML to 3.5 ML. XPS shows that SEE decreases O-rich As_2O_5 on GaAs(100) decreases by at least 13.5%, while As_2O_3 increases by at least 13.5%. Next, nano-bonded GaAs/Si interfaces are then imaged via Surface Acoustic wave Microscopy (SAM) and Transmission Electron Microscopy. SAM shows than 981% of GaAs nano- bonds successfully to Si at T <500K

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