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Development of InP Based Quantum Well Tunnel Junctions MICHAEL YAKES, MATTHEW LUMB, MARIA GONZALEZ, CHRISTOPHER BAILEY, IGOR VURGAFTMAN, ROBERT WALTERS, Naval Research Laboratory — In this presentation we demonstrate lattice-matched InAlGaAs quantum well tunnel junctions for an InP-based multi-junction cell. By including two 0.74 eV bandgap InGaAs quantum wells in InP-lattice matched InAlGaAs tunnel junctions with a 1.18eV bandgap, a peak tunnel current density of 113 A/cm^2 was observed, 45 times greater than a baseline bulk InAlGaAs tunnel junction. The differential resistance of the quantum well device is 7.52 x 10^4 Ωcm^2, a 15-fold improvement over the baseline device. The upper bound of the transmission loss to the bottom cell is estimated to be approximately 1.7%. Strain balanced quantum wells will be discussed which have the same benefits of the latticed matched tunnel junctions, but can be made accessible to both InP and GaAs based multi-junction architectures. We will also show the results of a study where a bulk, double heterostructure design is used to mitigate the effects of dopant diffusion and maximize the peak tunnel current, achieving a 15 times improvement in peak tunnel current over the baseline device. We propose that quantum well tunnel junctions with bulk heterostructure diffusion barriers could play a key role in improving performance both at one sun and high sun concentrations.

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