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A New Paradigm for Multijunction Solar Cells MARINA LEITE, CALTECH, ROBYN WOO, Spectrolab Inc., EMILY WARMANN, Caltech, DANIEL LAW, Spectrolab Inc., HARRY ATWATER, Caltech — We propose an approach for a multijunction solar cell (MJSC) based on direct band gap InAlAs/InGaP/InGaAsP/InGaAs alloys. Device simulations indicate that the proposed design can achieve over 50 % efficiency at 100-suns illumination by using an alloy combination with lattice parameter of 5.80 Å. For that, we created a virtual substrate for epitaxial growth. By relieving 40nm thick coherently-strained $In_xGa_{1-x}As$ films from InP substrates, full relaxation occurs preserving the crystalline quality of the films, as confirmed by X-ray diffraction, transmission electron microscpy and photoluminescence measurements. Once these films are transferred to a cheap support they can be used as a template for epitaxial growth with specifically chosen lattice parameter and therefore band gap energy. Our realization demonstrates the ability to control the lattice parameter and energy band structure of single layer crystalline alloy semiconductors in an unprecedented way. For the top subcell, we fabricated InAlAs solar cells with efficiencies > 14 % and Voc = 1 V. These results indicate that the novel MJSC design is feasible. Future directions and subcells performance will be presented.

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