Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Investigation of GaTlP for Use in Multijunction Photovoltaics C. DOWNS, J. CHIVERS, T. VANDERVELDE, Tufts University — To achieve the highest possible conversion efficiencies in multijunction photovoltaics, the individual layers of the device must both be lattice-matched and have optimal band-gap spacing. Lattice-matched or strain-compensated epitaxy is required for the growth of junctions thick enough to elicit high quantum efficiency. Ideally, for spectral matching, one would have an infinite number of junctions that are current-matched; however, fabrication of a large number of junctions is neither easy nor desirable because of problems that arise from series resistance. In the end, it becomes a balancing act where the optimal number of junctions for a high efficiency concentrator cell is 3-6 junctions, with the conversion efficiency directly linked to how well spacing of the band gaps of the cell are optimized for absorption of the solar spectrum. Unfortunately, many of the optimal lower band-gaps for these multijunction cells do not occur in the dominant materials system (i.e. Ge and mixtures of In, Ga, Al, As, and P). As such, of late there has been a strong push to characterize new materials in hopes of providing more design options for photovoltaic cells. GaTlP is one such material, theorized to be useful as one of the lower junctions of 3+-junction cells while still being lattice-matched to GaAs and Ge. In this research, the change in lattice constant and band gap of GaTlP with varying compositions are investigated first by computational simulation and then with physical devices. New efficiency records should be achievable by incorporating these new optimal junction materials into the design for multijunction cells. This development will help solar concentrator cells achieve grid parity, thereby becoming a viable renewable energy choice.

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Date submitted: 01 Dec 2009 Electronic form version 1.4