CORE
Metadata, citation and similar papers at core.ac.uk
Provided by NASA Technical Reports Server

N87-26450

GaAs HIGH EFFICIENCY LIMITS/GEOMETRIC ENHANCEMENTS

Mark Spitzer (Workshop Chairman)
Spire Corporation
Bedford, Massachusetts

This workshop addressed efficiency improvements that may be obtained in GaAs solar cells. The cell designs considered by the group ranged from conventional planar structures to novel devices employing superlattices or point contacts. This review will summarize the topics considered and will conclude with recommendations.

PLANAR CELLS

Planar GaAs cells have achieved AM0 efficiency of over 21% and the group consensus was that somewhat higher efficiency might be obtainable. The optical losses may be reduced by surface texture and by using low-obscuration metallization. Recombination may be reduced by improving the hetero-interface and space-charge region. It was pointed out that the Lincoln Laboratories' AlGaAs-GaAs heterojunction cell yielded a high diode ideality factor and a fill factor of 0.87. It would be interesting to determine how such fill factors can be obtained in heteroface cells.

The group discussed the manner in which the conversion efficiency of production heteroface cells might be improved. Reduction of window layer thickness was cited as a factor that would improve ones ability to form high quality antireflection coatings on LPE cells. The GaAs-on-Ge approach was cited as a way to improve the power-to-weight ratio. Simplification of the production process was also identified as a desirable goal. Such simplification might be obtained by eliminating the need for buffer layers prior to epitaxy. It was suggested that a further simplification would be obtained if the window layer could be grown directly on the substrate, which would form the base.

POINT-CONTACT AND OTHER IBC APPROACHES

Both Si and GaAs back contact designs were discussed. The radiation sensitivity is an especially important factor for such cells and it was agreed that more radiation testing and modelling are needed. It is generally assumed that concentrator systems provide enough shielding to circumvent radiation sensitivity; however, it was noted that this assumption may be invalid in many specific cases. It would therefore be useful to quantify what is meant by shielding in a concentrator system.

It was pointed out that back contact approaches are useful in III-V materials, owing to a need for co-planar, low shadow loss metallization. Structures of this type would be useful in thin-film approaches such as C.L.E.F.T. There was no consensus on the upper limit to the efficiency of point-contact GaAs cells, although

 PRECEDING PAGE BLANK NOT FILMED

it was agreed that such cells could be at least as efficient as planar front junction cells. There was some evidence presented suggesting that point-contact and grating cells would be more efficient than planar cells.

SUPERLATTICE CELLS

The workshop considered several superlattice structures, including nipi and compositional approaches. It was agreed that a more fundamental understanding of such devices is necessary before an evaluation can be made. For the nipi approach, it is necessary to justify the assumptions of increased radiation hardness. The composition superlattice approach requires more data on optical properties. In both cases, practical problems in fabrication need to be considered.

RECOMMENDATIONS

There was a consensus that research on improved efficiency should continue. It would be desirable to have a plan for transferring laboratory results to production cells.

To better understand point contact cells, it is necessary to predict or measure performance in radiation environments. It is therefore recommended that the radiation environment within a concentrator be quantified for orbits for which concentrator systems are intended. Radiation testing and related modelling should be carried out to determine whether these cells have a role in space.