GaAs SOLAR CELLS

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The GaAs Solar Cell Workshop considered a range of topics from "high efficiency" to "novel ideas." A majority of the 17 participants were interested, directly or indirectly, in the first GaAs production cell. This produced a lively discussion on the identification and solution of near-term problems.

The major thrusts proposed for GaAs were increased efficiency and improved radiation damage data. Current laboratory production cells consistently achieve 16 percent AMO one-Sun efficiency. The user community wants 18-percent efficient cells as soon as possible, and such a goal is thought to be achievable in 2 years with sufficient research funds. A 20-percent research cell is considered the efficiency limit with current technology, and such a cell seems realizable in approximately 4 years. Future efficiency improvements await improved substrates and materials. For still higher efficiencies, concentrator cells and multijunction cells are proposed as near-term directions.

When the efficiency is driven up by changes of cell structure, measurement techniques become more unreliable. The Workshop participants called for renewed, low-cost flight calibration of cells. Such a service through Lewis Research Center is terminating. Replacement options include another aircraft, balloon flights, or the shuttle. (A decision has been made by Lewis since the meeting to provide another aircraft for high-altitude calibration of solar cells.)

Radiation damage is the central problem impeding application of GaAs solar cells. Data sufficient to define its relatively unknown radiation behavior cannot be achieved <u>only</u> in the laboratory (with reasonable funds and time). Space flight data <u>are</u> needed (and may be obtained in planned DoD missions). The group recommended initiation of a continuing program to (1) characterize the practical degradation of production cells in space and in the laboratory; (2) understand the degradation in order to improve cell stability; and (3) promote interaction between the application community and the research community through damage modeling.

Annealing of radiation damage was considered a separate and more long range problem. Cell annealing would require a more complex or specialized array, which is well beyond current concepts. However, advanced concepts for annealing, such as current annealing and elevated temperature operation within a concentrator, were discussed. The application of annealing is expected to depend on whether annealing becomes mission enabling.

Thin cells are those which offer low cost, low weight, and high specific power. The <u>long-term</u> advantages of thin cell <u>research</u> to advance cell technology were <u>recognized</u>. A multibandgap cell <u>is similar</u> in general concept to several thin cells in optical series. Because heat conduction can be a critical problem for concentrator applications, thin cells may have special importance for high intensity uses. Also, if thin cells do not require as much total growth time (substrate plus active layers) as current GaAs cells, then shortened manufacturing time may translate into reduced cost. However, near-term application for a thin cell is limited by the mass of radiation covers, contact and cable size, and array weight and cost. The Workshop participants proposed that current cell technology be developed to the point of diminishing returns and that an effective concept for employing thin cells be developed before initiating development of very thin GaAs cells.

Concentrator cells appear potentially useful. Their development is progressing at a rate that permits practical application of GaAs concentrator cells. The applications offer cost reduction and radiation resistance. However, concentrators may pose special thermal management problems.

The price of GaAs cells is expected to decline shaply when an Air Force Manufacturing Technology program achieves its production goals. Two factors could further reduce the price of GaAs solar cells: (1) a volume of cells reaching 1 MWe/year; and (2) reduced price of substrates, which currently cost approximately $30 per square inch.

Among the new concepts endorsed by this Workshop are back surface fields and other built-in fields and materials tailoring for maximum efficiency (especially $Al_xGa_{1-x}As$).

In summary, the major recommendations are

1. Achieve 18-percent production cell and a 20-percent research cell (2 to 4 years).

2. Begin a continuous radiation damage program involving practical assessment of damage, understanding of damage mechanisms and modeling.

GaAs Workshop Participants

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