SILICON RESEARCH AND TECHNOLOGY WORKSHOP REPORT

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The Silicon Research and Technology Workshop discussed materials, structures, processing, modeling and measurements of high efficiency silicon solar cells. In the materials area, highlights included: 1) the possibility of improving cell voltages by reducing minority carrier mobilities in critical regions of the solar cell; 2) the need for and possibility of lowering the surface recombination velocity for improvement of open circuit voltage in shallow junction cells; 3) the present need for improved lifetime in high resistivity cells; and 4) the potential for new materials such as polycrystalline or dendritic web material to perform well at end-of-life in a radiation environment.

In the area of structures, distinction was made between those for terrestrial use and those that would survive radiation environments. It was felt that tandem junction, induced junction and M-I-S cells have promise in the terrestrial area but have shown limitations under irradiation. Use of thin cells, "dot" contacts, thin, heavily doped, surface layers, and back surface fields have shown their importance under the proper conditions; improvements are still expected from these areas. The use of back surface reflectors, transparent back cells, and IR transparent arrays are all deemed necessary for low temperature operation in space.

Processing was covered to some extent in the discussions of structures and materials but new areas such as epitaxial growth and laser or electron-beam annealing (and diffusion) were proposed as having certain advantages over more conventional techniques. More work on these techniques should help overcome problems which have limited their full utilization. The means of reducing the surface recombination velocity and of improving the influence of P^+ back layers on heavily doped silicon were highlighted as critical problems at the present time. Solar cell modeling appears to be adequate for guidance of research at the present time. However, as fabrication limits are pushed, the uncertainties in structure and nature of thin, heavily doped, silicon layers and the associated surfaces may require new data and probably new models. The study of these limiting structures will require some new measurement techniques and some methods were discussed for a more sensitive determination of surface recombination velocity on appropriate test structures rather than on finished cells. If mobility control is envisioned, measurement techniques compatible with studying gradients throughout the material may be necessary.

In general, the discussion pointed out present results as material and processing limited. Theoretical structures have been proposed to overcome these problems, but even if practice cannot meet theory, there was optimism about the knowledge obtained in pursuit of the goals providing new avenues to follow. The possibility of a quantum jump in cell efficiency must not be discounted so that the reality of an 18 percent silicon solar cell might be practical and not just a one-shot laboratory accident.