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ADVANCED SILICON SHEET

Anthony Briglio, Jr., Chairman

Ten presentations were made at this session covering research on silicon-shaped sheet technology.

JPL reported highlights of the FSA-sponsored Silicon Ribbon Stress/Strain Workshop that was held January 23 and 24, 1985, at the Mobil Solar Energy Corp., Waltham, Massachusetts. The presentations and discussions were aimed at acquiring a generic understanding of the sources of stress, deformation, and structural characteristics occurring during the growth of silicon ribbon.

Westinghouse Electric Corp. reported on its program to develop the technology of the silicon dendritic-web ribbon growth process. The effort is being concentrated on the area rate and quality requirements necessary to meet the JPL/DOE goals for terrestrial PV applications.

JPL described progress made in the study of defect characterization of silicon dendritic-web ribbon, using chemical etching combined with optical microscopy, as well as the electron-beam-induced current (EBIC) technique.

Cornell University reported progress on the electrical, structural, and chemical characterization of silicon sheet material. In the study on high-temperature deformation of Westinghouse dendritic-web ribbon, experimental creep tests were performed at Mobil Solar Energy Corp. in four-point bending under constant load conditions, and unusual behavior was observed. Also, measurements of oxygen content in web ribbon were made.

In the study of stress/strain relationships in silicon ribbon, the University of Kentucky calculated numerous solutions for stresses, strain rates, and dislocation densities through the use of the Sumino model. It has been concluded that many cases of failure of computer solutions to converge are analytical manifestations of shear bands (Luder's bands) observed in experiments.

Mobil Solar Energy Corp. reported on stress and efficiency studies on sheet silicon. It was found that the bulk diffusion length of stressed float zone (FZ) and Czochralski (Cz) silicon is limited by point defect recombination to about 20 μm in dislocation-free regions after high-temperature heat treatment and stress application.

Energy Materials Corp. reported on progress in developing a low-angle silicon sheet growth method (LASS) growth process. A video recording of ribbon growth at a pull speed of 40 cm/min was shown, including an example in which both dendritic and planar growth occur simultaneously in the same ribbon.

The Massachusetts Institute of Technology discussed the study of high-speed growth of silicon sheet in inclined-meniscus configurations. It was concluded that the maximum growth rates in vertical and inclined growth are set by thermal-capillary limits.

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The Solar Energy Research Institute reported on its study of silicon sheet material requirements for high-efficiency solar cells. Research continued on obtaining long-lifetime single-crystal FZ silicon and on understanding and reducing the mechanisms that limit the achievement of long lifetimes.

The University of Illinois at Chicago presented results of the program on developing an understanding of the basic mechanisms of abrasion and wear of silicon and on the non-destructive measurement of residual stresses in sheet silicon. Experiments were conducted at various temperatures and in the presence of various fluids. In abrasive wear, it was shown that dislocations, microtwins, and cracks are generated beneath the contact surface. Residual stresses in ribbon produced by Mobil Solar Energy Corp. by the EFG process were measured by use of a shadow moiré interferometry technique.