LIMITING PROCESS IN SHALLOW JUNCTION SOLAR CELLS*

A. Meulenberg and E. Rittner
COMSAT Laboratories

In extending the COMSAT violet and non-reflective cell technology to lower resistivities, several processes limiting output power were encountered. The most important was the dark diffusion current due to recombination at the front grid contacts. After removal of this problem by reduction of the silicon-metal contact area (to 0.14 percent of the total area), the electric field enhanced junction recombination current J_r was the main limitation (Figure 1). Alteration of the diffusion profile to reduce the junction field is shown to be an effective means of influencing J_r. The remaining problems are the bulk recombination in the n+ layer and the surface recombination at the oxide-silicon interface; both of these problems are aggravated by band-narrowing resulting from heavy doping in the diffused layer. Experimental evidence for the main limitations is shown in Table 1, where increased diffusion temperature is seen to reduce both the influence of the front grid contacts and the junction electric field by increasing the junction depth. The potential for further significant improvement in efficiency appears to be high.

TABLE 1. 1.2Ω-cm (5-PERCENT CONTACT AREA) CNR CELLS DIFFUSED AT DIFFERENT TEMPERATURES

Temperature	J_{do} (pA/cm^2)	J_r (at P_{max}) (mA/cm^2)	J_{SC} (mA/cm^2)	V_{OC} (mV)
760°C	12 ± 1	27 ± 1	42.5	558
790°C	4.7 ± .15	10 ± 1	42.5	583
820°C	4.5 ± .6	7 ± 3	42.5	588
850°C	3.8 ± .2	4 ± 2	41.8	595

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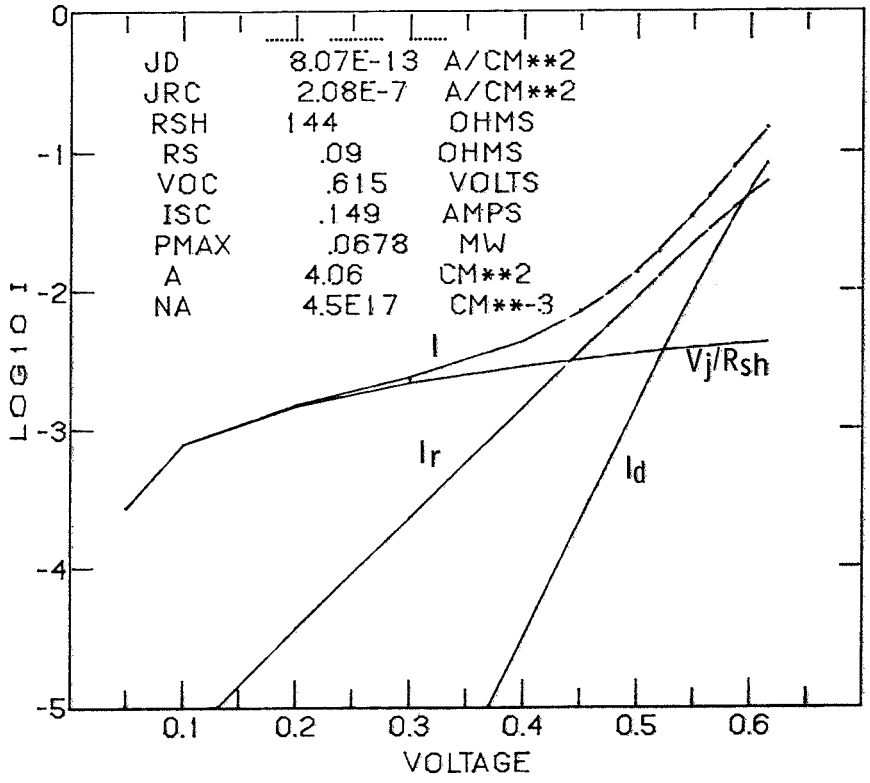

Figure 1. IV Analysis of a Shallow (0.1-μm) Junction 0.1-Ω-cm Solar Cell with Low Contact Area (0.14%)