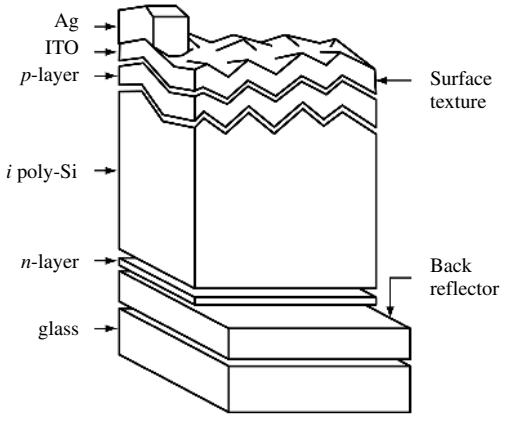

Figure 8.10 Illustration of the structure of a STAR cell. The μc-Si I-layer is typically 2 to 3 μm in thickness

Table 8.3 Measured $I-V$ parameters of STAR cells of different film thickness. The efficiencies are measured as the *Aperture efficiency*, which includes metallization, and *inside efficiency*, which excludes metallization area

Cell thickness	J_{SC} [mA/cm^2]	V_{OC} [mV]	FF [%]	Total area efficiency [%]	Active area efficiency [%]
1.5	22.9	526	77.2	9.3	–
2.5	24.39	510	75.5	9.4	9.8
3.5	26.12	480	74.8	9.4	9.8

of about 10^{15} to 10^{16}/cm^3. This layer is followed by depositions of a p-type Si film, a layer of ITO and an Ag-grid electrode. Some of the results obtained on the STAR devices are given in Table 8.3. This approach has shown astounding progress, manifested in a cell of about 10.4% efficiency, in a very short time. Initial theoretical calculations indicate that 16 to 18% cell efficiencies are possible with moderate grain size and some novel cell designs. It is important to note that the main part of the device uses an intrinsic material based on an nip structure. As pointed out earlier, the drift field within the i-layer can greatly increase the effective minority-carrier lifetime. However, because GBs exist within this region, the structure is prone to shunting effects that can limit the V_{OC} and FF. It is interesting to note that although the J_{SC} values increase with thickness, the V_{OC} values of the STAR cells decrease with increasing thickness. This behavior was explained in the previous section in Figures 8.1 and 8.2.

A novel approach for obtaining high V_{OC} could be to use thin-film material consisting of a mixture of a-Si and μc-Si. Although the physics of the μc-Si phase within an a-Si matrix is only beginning to be studied, it is likely that properties of such a composite phase can be tailored to exhibit behavior of either species. Thus, an a-Si-rich phase in the I-region can display higher V_{OC}, whereas a μc-Si-rich phase can yield higher J_{SC}. Indeed, there appears to be some evidence of this behavior. Researchers from Institut fur