



**Figure 8.7** A schematic of the structure of the ZMR solar cell with a 60- $\mu\text{m}$  poly-Si active thickness, and an illustration of the process steps involved in cell fabrication

Following the success of researchers who fabricated thin cells using conventional technology of wafer thinning and device processing, several laboratories began investigating alternate methods to produce thin films of Si in which production of Si film and cell processing are compatible. Some of the considerations that went into the qualitative cell design are identified below.

*Efficient carrier generation.* Thin Si films have an inherent drawback of being weakly absorbing in a significant region of the solar spectrum. A well-known solution to this issue is to incorporate light-trapping by creating surface roughness or texture. The initial attempts at fabricating TF-Si cells relied heavily on this approach. In most cases, back reflections were expected to come from refractive-index discontinuity at the backside of the film and the film support. Some of the approaches resemble those used in a-Si technology. But there are many issues that still remain unresolved about the light trapping in thin films. Some of the details of light-trapping and its applications to thin cells are discussed in the next section.

*Efficient carrier collection.* Although TF-Si cells are expected to perform well with poor material quality, the minority-carrier diffusion length must still be longer than the film thickness. An approach that can circumvent this restriction is to use a pin structure or multiple junctions, in a manner similar to that in a-Si solar cells.

*Mechanical support.* A thin Si film, less than 10  $\mu\text{m}$  thick, is not a self-standing structure; it needs a support. Typically, two approaches may be used for supporting thin-film solar cells: (1) the cell is fabricated on a temporary substrate that has suitable properties to participate in the device processing, and it is then transferred or lifted off to a permanent support. In this case, the cell fabrication itself can be done using conventional processes,