12.7.2 Critical Issues for Further Enhancement and Future Potential

To increase application of a-Si-based PV significantly beyond today's level, the following issues are critical and must be addressed.

1. Light-induced degradation must be better understood. Approaches for reducing or controlling the degradation need to be further developed. At this moment, there are many engineering compromises in the device design, such as the use of thin *i*-layers to limit the degradation. If the materials can be made more stable under light, these compromises can be relaxed and the device can be made with much higher efficiency.
2. As the gross defects associated with light soaking are minimized, we shall need to explore improvements in the drift mobility of holes.
3. We need to improve a-SiGe so that narrower band gap materials can be incorporated into cells and more of the infrared region of the solar spectrum can be exploited.
4. Faster deposition processes need to be developed that (at least) preserve the conversion efficiencies achieved by present processes. This is critical for low-cost and high-throughput manufacturing. In addition, these high-rate processes must also achieve high gas utilization.
5. Microcrystalline Si-based solar cells need to be fully explored as alternative, narrow band gap component cells in tandem or triple-junction cells. We expect that rather fast, >20 Å/s, deposition processes will be required. The device physics of μc-Si-based solar cells, especially the possibilities for improving the open-circuit voltage, need to be better understood.
6. Module design needs to be further improved and the costs associated with framing and encapsulation need to be further reduced. At the same time the durability of modules in standard environmental tests must be preserved or improved.
7. We need to find new applications for a-Si PV products in all of its present markets, including building-integrated PV, space power, and consumer electronics as well as grid-connected, large-scale power generation.

As these critical issues are successfully addressed, we expect that a-Si-based solar cells will become more inexpensive, that there will be explosive increases in the volume of production and widespread expansion in the market. Amorphous silicon–based cells will become an environmentally friendly, inexpensive, and a ubiquitous source of electrical power for our life on Earth!

12.8 ACKNOWLEDGMENTS

This work was supported by the Thin Film Photovoltaics Partnership of the US National Renewable Energy Laboratory. We thank Rana Biswas (Iowa State University), Nerio Cereghetti (LEEE), Gautam Ganguly (BP Solar, Inc.), Subhendu Guha (United Solar Systems Corp.), Scott Jones (Energy Conversion Devices), Stan Ovshinsky (Energy Conversion Devices), Bolko von Roedern (National Renewable Energy Laboratory), Chris Wronski (Pennsylvania State University), and Jeff Yang (United Solar Systems Corp.) for their generous help in writing this article.