The NASA Glenn Research Center has recently developed a microelectronic power supply for a space flight experiment in conjunction with the Project Starshine atmospheric research satellite (*http://www.azinet.com/starshine/*).

This device integrates a seven-junction small-area GaAs monolithically integrated photovoltaic module (MIM) with an all-polymer $LiNi_{0.8}Co_{0.2}O_2$ lithium-ion thin-film battery. The array output is matched to provide the necessary 4.2 V charging voltage, which minimizes the associated control electronic components. The use of the matched MIM and thin-film Li-ion battery storage maximizes the specific power and minimizes the necessary area and thickness of this microelectronic device. This power supply was designed to be surface-mounted to the Starshine 3 satellite, which was be ejected into a LEO with a fixed rotational velocity of 5° per second. The supply is designed to provide continuous power even with the intermittent illumination due to the satellite rotation and LEO [58].

10.6.4 High Specific Power Arrays

To achieve an array specific power of 1 kW/kg, a much higher cell specific power will be necessary. Similarly, the blanket specific power (i.e. interconnects, diodes, and wiring harnesses) must be over 1 kW/kg as well. The APSA assessment determined that the mass of the deployment mechanism and structure is essentially equal to the blanket mass for a lightweight system [21]. Therefore, a blanket specific power of approximately 2000 W/kg would be necessary to achieve a 1-kW/kg array. NASA is currently sponsoring an effort by AEC-ABLE Engineering to develop lightweight thin-film array deployment systems.

Gains in array specific power may be made by an increase in the operating voltage. Higher array operating voltages can be used to reduce the conductor mass. The APSA was designed for 28 V operation at several kilowatts output, with the wiring harness comprising $\sim$10% of the total array mass, yielding a specific mass of $\sim$0.7 kg/kW. If this array was designed for 300-V operation, it could easily allow a reduction of the harness specific mass by at least 50%. This alone would increase the APSA specific power by 5% or more without any other modification.

The extremely high specific power arrays that need to be developed for SEP and SSP applications will require lightweight solar arrays that are capable of high-voltage operation in the space plasma environment. SEP missions alone will require 1000 to 1500 V to directly power electric propulsion spacecraft (i.e. no voltage step-up is required to operate the thrusters). NASA has proposed a thin-film stand-alone array specific power that is 15 times the SOA III-V arrays, an area power density that is 1.5 times that of the SOA III-V arrays, and specific costs that are 15 times lower than the SOA III-V arrays [59].

10.6.5 High-radiation Environment Solar Arrays

There are several approaches to mitigating the effects of a high radiation on a solar array. The simplest is to employ thick cover glass (assuming that a commercial source could be developed). Thick cover glasses protect the cell from the highly damaging low-energy protons, but will cause a significant decrease in the specific power of the array. However, this can be reduced if one adopts a concentrator design, assuming of