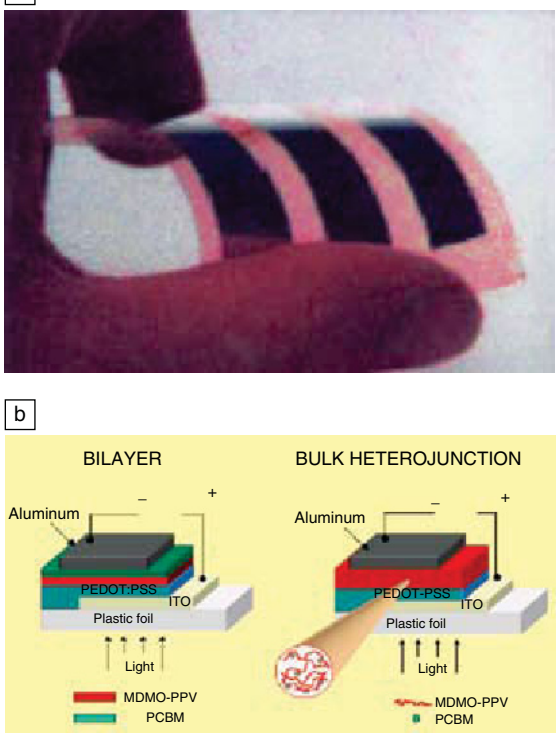

Figure 5. Organic electronic structures for rural and urban lighting: (a) flexible organic solar cells and (b) schematic of possible layered structure. *Note:* MDMO-PPV, poly[2-methoxy-5-(3′,7′-dimethyloctyloxy)-*p*-phenylenevinylene]; PCBM, [6,6]-phenyl C61 butyric acid methyl ester; PEDOT:PSS, poly(3,4-ethylenedioxythiophene) poly(styrenesulfonate).

opment of organic electronic structures that could provide the potential for low-cost solar energy. In the long term, such advances have the potential to reduce the cost of solar cells by a factor of 10. Such a reduction could greatly facilitate the global applications of solar energy in both the developed and the developing world. However, additional research is needed to improve the efficiencies of the solar cells and the stability of the organic electronic structures for rural and urban electrification (**Figure 5**).[4] Ongoing materials research efforts in this area are motivated by issues related to charge transport across bilayers and bulk heterojunctions and polymer/interfacial stability. This is especially true for organic solar cells and organic light-emitting devices, which are essentially solar cells run in reverse.

Before closing, it is important to note that recent advances in research have resulted in a rapid increase in the efficiencies of organic solar cells from about 1% to 6%.[5] If the current trend continues, it is likely that organic electronic structures could soon become competitive alternatives to commercial silicon-based solar cells that have efficiencies between 5% and 15%. This has motivated an integrated research effort in the global materials community.

Acknowledgments

W.O.S. acknowledges the financial support of USAMI through a grant from the Division of Materials Research (DMR 0231418) of the National Science Foundation. Appreciation is extended to the Program Manager, Dr. Carmen Huber, for her encouragement and support.

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The 3 GW Initiative

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California continues its tradition of leading the United States in environmental stewardship through the California Solar Initiative (CSI), a $3.3 billion program established in January 2006. The goal is to generate 3 GW of electricity by 2017 through photovoltaic methods by installing solar cells on the roofs of existing and new residential and commercial buildings (see **Figure 1**).[1] CSI will "reduce our output of greenhouse gases by 3 million tons," California Governor Arnold Schwarzenegger said in a speech given in October 2006. "That is equivalent to taking one million cars off the road."

Although specific materials technologies are not mandated by the program, photovoltaic systems "are expected to be the common technology to receive incentives" according to the *CSI Handbook*.[2] The fact that incentives paid to participants are based on the amount of electricity generated will motivate consumers to adopt the most efficient solar cell technologies, thus increasing the performance level of the "common technology." This should result in significant market pressure to drive competition between photovoltaic cell manufacturers to produce the highest quality product.

Figure 1. California homes and commercial buildings with rooftop photovoltaic solar cells installed as part of the California Solar Initiative. *Credit:* Sacramento Municipal Utility District, www.smud.org (accessed January 2008).

The current list of approved products includes 861 photovoltaic modules from 44 companies worldwide.[3] Approved modules are primarily amorphous Si, single-crystalline and multicrystalline Si, and thin-film CdTe devices. Prior to approval, all photovoltaic modules are tested according to PVUSA Test Conditions (PTC), which yields a wattage rating based on 1000 W/m^2 solar irradiance, 20°C ambient temperature, and a wind speed of 1 m/s. PTC measurements for the 861 approved modules range from 9.9 W to 1545.5 W. In addition, critical system components must have been commercially available for at least one year to be eligible for the program.

CSI's initial provisions called for a one-time, up-front rebate called the Expected Performance-Based Buydown (EPBB). The payment was to be made based on the calculated capacity of each system's electricity production, taking into account such variables as the amount of incoming sunlight in a particular geographic region, the efficiency of the installed solar panels, the tilt of the roof, and estimates of shading effects.

On August 24, 2006, however, the California Public Utilities Commission revised this system in favor of a Performance-Based Incentives (PBI) plan.[4] PBI called for monthly payment of incentives to owners of systems with a capacity of 100 kW or more based on the actual metered amount of electricity produced. (The EPBB plan is still in effect for systems smaller than 100 kW.) Current incentive levels are $2.50 per generated watt for residential and commercial participants, with rates scheduled to decrease according to a fixed schedule over the 10-year lifetime of the program.

The early success of the CSI effort is evident in the fact that 1157 projects valued at 9.4 MW in generated electricity and $25 million in incentives have already been completed. In addition, there are currently 5,109 applications for installation of photovoltaic systems that would generate 160.5 MW of electricity and $320 million in incentives. The pace of applications is accelerating, starting with approximately 200 in January 2007 and increasing to over 1200 in the month of August alone as the program becomes more widely known.

Ten percent of the $3.3 billion has been set aside for low-income and affordable housing.[5] In addition, the California Energy Commission is in charge of a 10-year, $400 million New Solar Homes Partnership, to encourage new home builders to include solar energy capabilities in their designs.[6] The fact that new home builders are not *required* by CSI to include solar cells in their designs continues to be a point of debate among Californians.

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