The Push for Cost Effective Solar Photovoltaics, an Opportunity for Nanomaterials

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Rising atmospheric levels of carbon dioxide and decreasing stability of conventional energy sources provide a compelling imperative to develop a range of practical energy alternatives. Solar photovoltaics have a chance to play a significant role, particularly in the realm of distributed power generation, and recent dramatic growth in the photovoltaics industry shows no sign of abating. However, to contribute significantly to the future energy generation landscape, substantially reduced cost per Watt of power generated will be required. These factors combine to create the current climate of investment and innovation in photovoltaics which will carry us well beyond the first generation silicon wafer-based rooftop modules and into full scale commercialization of second generation, thin film modules. However, achieving cost reduction targets will require the maturation of a third generation of photovoltaics which must drastically cut fabrication costs while maintaining practical power conversion efficiencies. Diverse strategies are currently under development, with nanomaterials playing an enabling role in many. Printable nanoparticle-containing inks promise thin film photovoltaics at a fraction of their conventionally-fabricated cost. I will outline some variations on this strategy and discuss some possible road blocks. In addition, a wide range of low cost materials are being incorporated into nanostructured heterojunctions which offer the possibility of compensating for limited electronic performance of the materials. I will discuss the physical foundation for these bulk heterojunction solar cells and briefly review implementation strategies using conducting polymers, bucky balls, and semiconductor nanocrystals. The field remains wide open to new strategies and innovative implementations, and contributions from diverse perspectives will drive some of these new solar cell concepts to become technologies to the benefit of society at large.