THE DOW LECTURE

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Photovoltaic Solar Energy – Status, Challenges, and the Future

Solar energy may well represent our best hope for generating large amounts of energy in a sustainable way and for an acceptable price. Sunlight is efficiently converted to electricity by solar cells, more properly "photovoltaics". While expensive at the moment, breakthroughs are bringing the price down and renewable energy may be cost competitive even with coal-generated power within the next ten years. As a result the global photovoltaic industry is growing at 40% per year. Ultimately it may become an industry on a scale larger than the microelectronic and automotive industries combined. A description of current energy sources and requirements for energy in the future is provided as a motivation for studying photovoltaics. A review of both current approaches to photovoltaic devices and materials and novel concepts being explored is presented. Fossil fuels are limited and many may go through a production maximum in our lifetimes. The only practical options to create the >3 TWyr/yr of energy we currently consume are nuclear, wind, solar, and biomass. Of these solar energy is by far the most efficient. Current devices, reviewed briefly, are based on Si (expensive but a known quantity); CdTe (experienced a breakthrough recently), $Cu(In,Ga)Se_2$ and related materials (the best thin film devices but hard to manufacture), a-Si:H (promising early but fading compared to others), and high efficiency multijunction devices (expensive in most forms). Novel concepts include microtransfer printing of Si, organic photovoltaics, nanoparticle/multiexciton generating devices, intermediate band devices, photoelectrochemical cells (including solar hydrogen), etc. The advantages, disadvantages, issues, and scientific/technical challenges associated with each of these are reviewed briefly.

Biography:

ANGUS ROCKETT is a Professor and Associate Head of the Department of Materials Science and Engineering at the University of Illinois. He is a member of the Board of Directors and a Fellow of the AVS and was a rotating Research Program Administrator at the Office of Basic Energy Sciences at the Department of Energy in 2000. His research has concerned ion-assisted growth of semiconductors and fundamental science of growth of materials by molecular beam eptiaxy. He has studied the basic science of solar cell materials and the operation of solar cell devices for 20 years using virtually all of the common materials microchemical and microstructural analysis techniques from SIMS and TEM to STM and photoluminescence. He has also worked on self-assembled nanostructures, MEMS devices, silicide reactions for VLSI contacts, Si-Ge oxidation kinetics for gate dielectrics, superconducting cavity resonators as temperature probes, and optical spectroscopic analysis of combustion. He is an AVS Short Course Instructor for the Photovoltaics and Sputter Deposition of Thin Films short courses. He has also given short courses in fundamentals of thin film solar cells at the IEEE Photovoltaic Specialists Conference, on characterization of photovoltaic materials at the Materials Research Society, and has given short courses on thin films and photovoltaics in China, Mexico, Sweden, Israel, Brazil, and elsewhere.

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Tech L211, 4:00pm
5:15pm Reception-Cook Hall Atrium