Current GREEN Center Research Topics:

Modeling and Simulation for solar structure. Light-trapping modeling and simulation in thin-film solar cells with ZnO nanowire arrays and other nanopillar arrays. Resonant absorptive (plasmonic) properties of 3D nanostructure PCs will be thoroughly investigated for their potential applications in the enhanced solar energy absorption compared with an identical device without nanostructures (Huang).

Nanofabrication. Design and fabrication of various nanoplasmonic structures and nanoelectrodes for nanodevices by using the JEOL JBX-5500FS E-Bean Lithography system. Also includes optical characterization of these structures for their potential applications in solar cells (Fisher).

Chalcogenide light absorber and nanowire solar cells. Copper Indium Gallium Sulfide or Selenide (CIGS) and Copper Zinc Tin Sulfide or Selenide (CZTS) are prepared by both vacuum and solution processes. Optical, electrical, and structural properties of these materials are investigated. Both thin-film and nanowire solar cells are fabricated. A technical procedure for fabricating nanowire solar cells is being developed. Nontoxic buffer layers using Mg-doped ZnO as a buffer have been fabricated (Chen).

GaN Nanorods. Focus is on the development of nitride solar cells using GaN nanorods. Research includes growth of high quality InGaN nanorods with In concentrations from 25% to 41% by MBE technique. New understanding of material growth kinetics and thermodynamics has been achieved. The plasmonic template was also fabricated by utilizing the implantation technique, which is a cheap process (Seo).

Glancing Angle Deposition (GLAD). Finite difference time domain (FDTD) optical modeling, GLAD Al-doped ZnO (AZO) nanorod arrays, conformal coatings by Small Angle Deposition (SAD). Organic solar cells utilizing GLAD metallic nanostructures and GLAD nanostructures for dye-sensitized solar cells. Utilize low-cost materials by enhancing charge carrier collection and light trapping properties (Karabacak).

Graphene Window. Large-area single- and few-layer graphene is grown by CVD in vacuum and its optical and electrical properties are investigated. Currently graphene with a size of 2 x 2 cm^2 have been obtained. A large size can be obtained easily if using a furnace with a large diameter. By controlling the growth condition, the number of layers can be easily controlled. This will be used for solar cell windows (Chen).

Silicon materials. Research includes Al-induced nanoroot growth within the amorphous silicon films, deposition of polycrystalline Si and property characterization. These special structures will be used for solar cell device fabrications. This also includes Schottky contact solar cells (Naseem).

SiGeSn. Deposition of high-quality epitaxial Si, SiGe, GeSn, SiGeSn, SiC films on large area substrates at low temperature for fabrication of various optoelectronic devices including photodetectors, lasers, and solar cells. SiGeSn provides the only currently known way to viably engineer 1.0 eV bandgap direct bandgap semiconductors for an ideal three-junction high-efficiency solar cell, a holy grail for high-efficiency advanced MJ solar cells (Fisher).

Thermoelectroc materials and devices. N-type Bi2Te3 (nanoparticles and nanoporous structures) and P-type antimony telluride (SbTe3) thermoelectric materials are being investigated to achieve a high figure of merit. The improvement of the figure of merit of thermoelectric inks is achieved by using nanoporous thermoelectric fillers and polymer coated carbon nanotubes as the electric-conductive agents (Varadan).