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National Institute for Nano Engineering

Next Generation Photovoltaics

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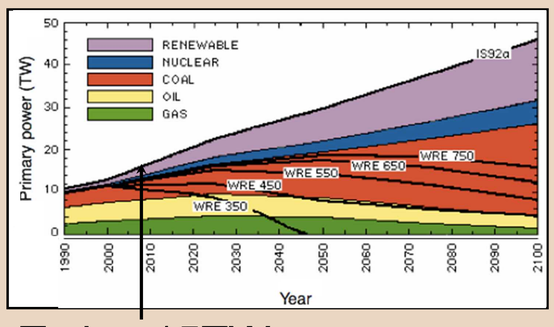
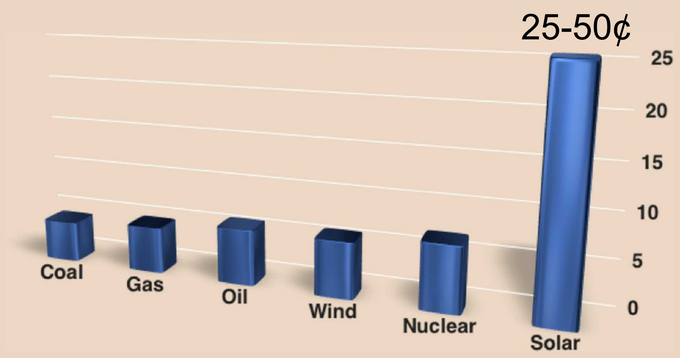
Motivation



Today 15TW

Challenges



N. Lewis, http://nsl.caltech.edu/energy.html

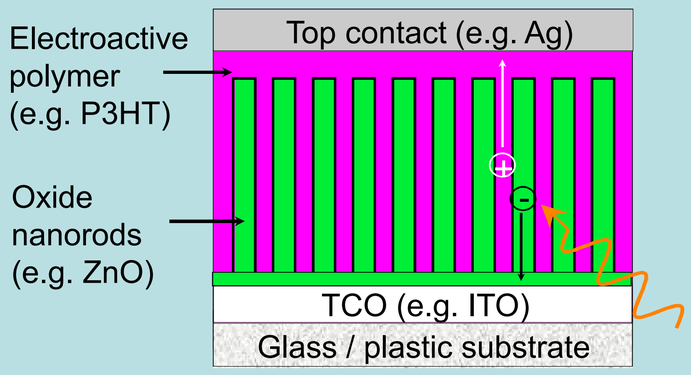
Needs new materials and technologies!

Organic Photovoltaics (OPVs)

Konarka, http://www.konarka.com/

- Low materials and balance of systems costs
  - Low temperature, non-vacuum synthesis
  - Printed on flexible substrates using high speed roll-to-roll processing
- Near term target: 5-10% power conversion efficiency
  10,000 hr lifetime
- Current technology: ≥ 5% efficiency

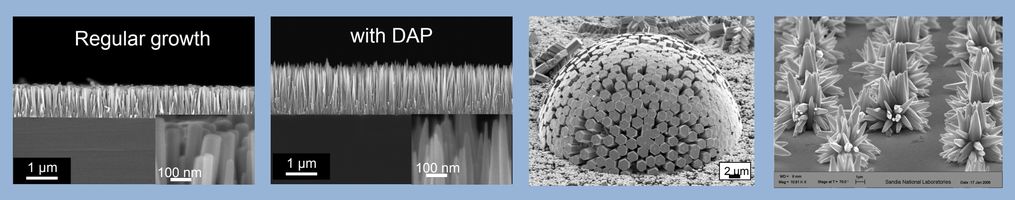
Nanostructured Oxide - Conducting Polymer Hybrid Solar Cells



- High electron mobility in crystalline oxide
- Ordered nano-architecture with line of sight transport paths
- Potential interfacial energy band engineering via doping and alloying of oxides
- Environmental stability (processing done in ambient)
- Better lifetime (shelf lifetime > 1 yr)

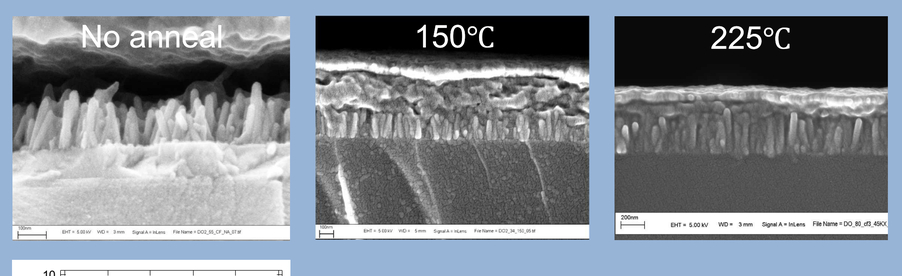
Sandia's Current Efforts

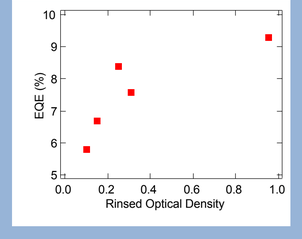
Oxide Nanostructure Synthesis



- Vary shape with organic growth modifiers
- Controlled nanorod array orientation & density
- Complex hierarchical nanostructures
- (Organic-) Templated growth on surfaces
- Doping to alter conductivity, e.g. In, Al, Ga, Li

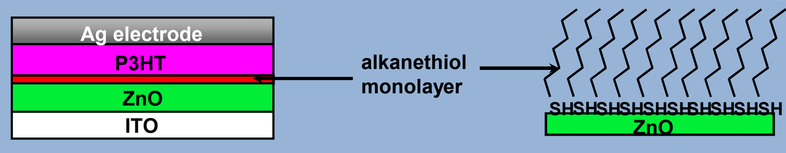
Polymer Infiltration



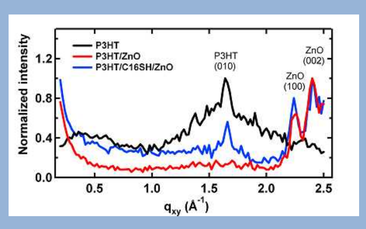


- Solvent affects infiltration
- Annealing enhances infiltration
- More polymer in the nanorod array, better device performance

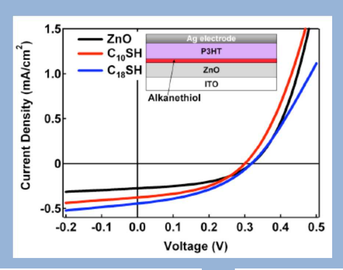
Interfacial Modification to Enhance Charge Transfer



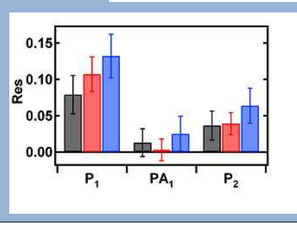
- Promote polymer crystallinity

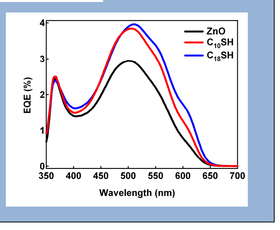


- Increase short-circuit current



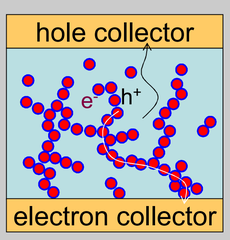
- Reduced recombination

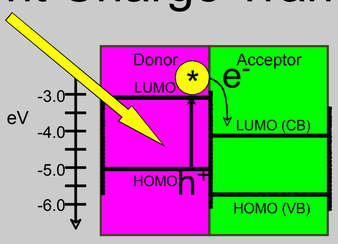




Nanoengineering challenges

Interfacial Architecture & Efficient Charge Transfer





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