



ZnO Nanodevices

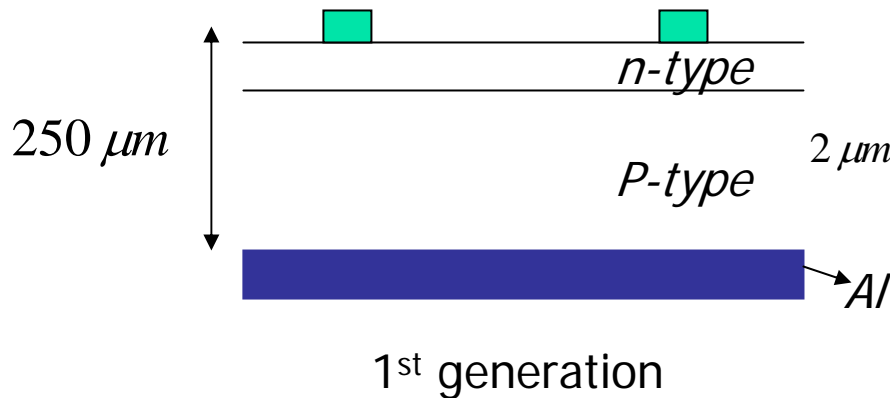


Goal

- To study the photoresponse and electrical properties of solar cell.

Solar Cell

➤ Generations of solar cell

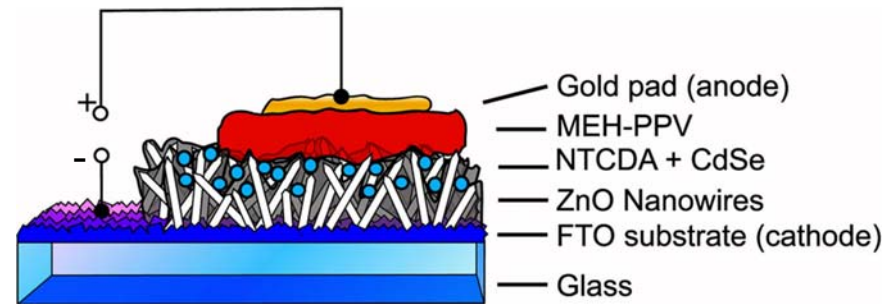


1st generation

➤ 1st Generation: *c*-Si solar cells

High quality single crystal photovoltaic devices

Labor and energy intensive—
Expensive



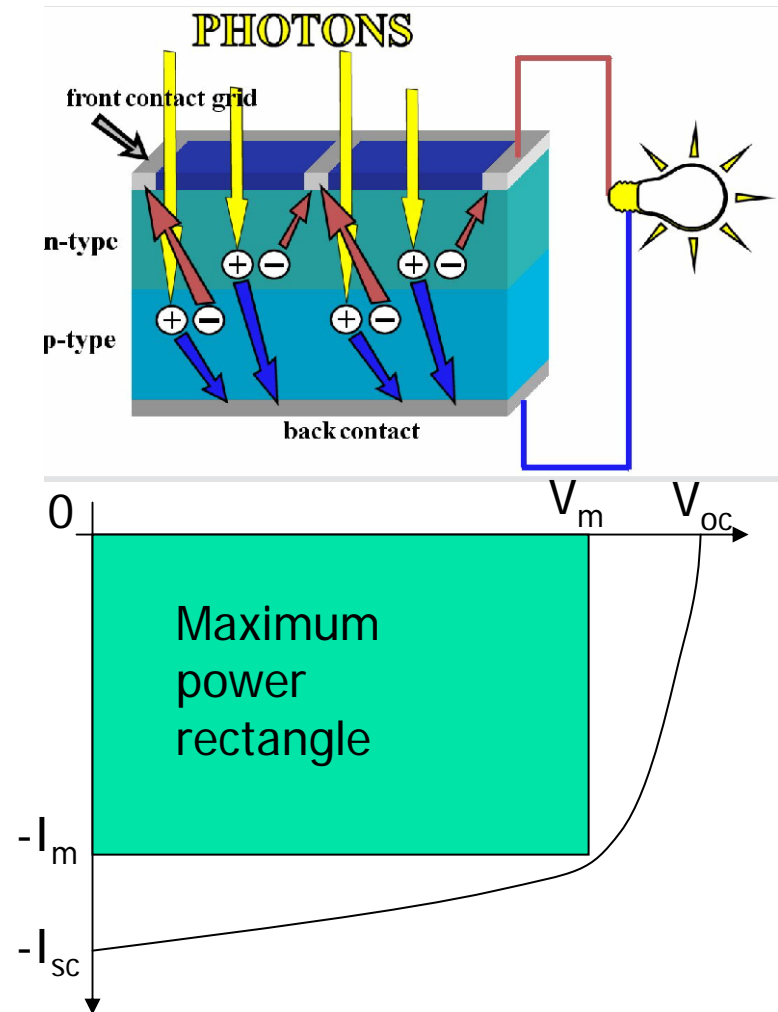
3rd generation

➤ 3rd Generation: Advanced thin film cells

Incorporate advanced materials:
Conductive polymers, quantum dots, light absorbing dyes and nanocrystals

Solar Cell

- Photovoltaic cell: Converts light energy into electrical energy.
- Incident light with enough energy ($E_{\text{photon}} > E_g$) excites an electron from the valence band to the conduction band, producing an electron-hole pair.
- The P-N junction separates the charge carriers and conducts them to either the anode (holes) or the cathode (electrons).





Measurement Setup

- Current-Voltage (I-V) characteristics: Tests electrical properties of solar cell
- Used Keithley 236 Source Measure Unit (SMU)
- Procedure
 - ❖ Sample illuminated from below by incandescent light
 - ❖ Applied a voltage from -1.0 to 1.0 V
 - ❖ Measured current response of illuminated Au contact
 - ❖ Also measure current response to voltage sweep in the dark for comparison

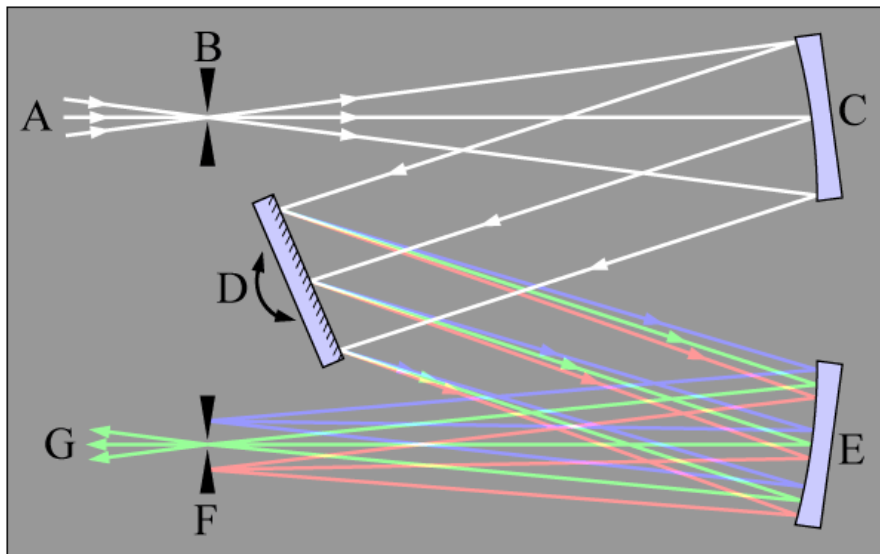


Measurement Setup

- Spectral Response was measured with an EG&G 5208 Two Phase Lock-in Analyzer
- Keithley 428 Current Amplifier was connected to the Lock-in Analyzer
 - ❖ Current amplifier applies gain to photogenerated signal
 - ❖ Photocurrent and quantum efficiency can be calculated from data output

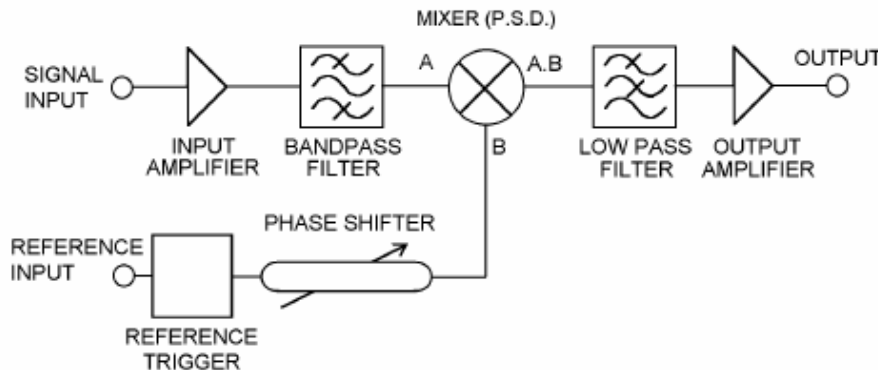
Monochromator

- A monochromator is an optical device that transmits a selectable narrow band of wavelengths of light.

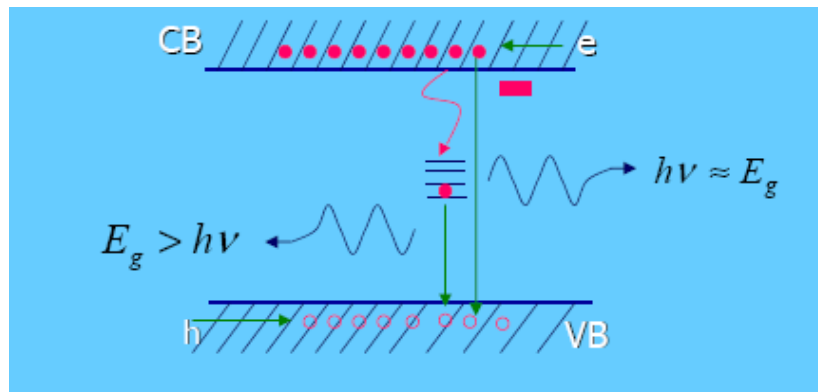
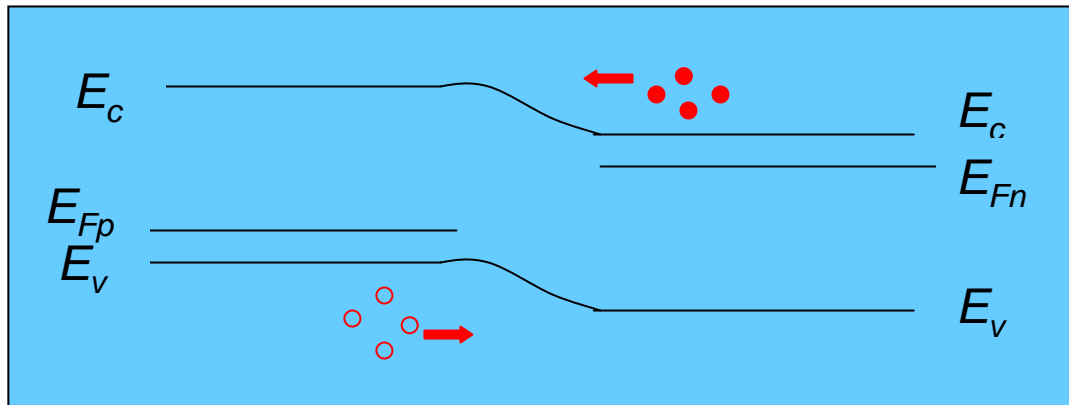


Lock-in Amplifier

- A lock-in amplifier takes the input signal, multiplies it by the reference signal, and integrates it over a specified time. The resulting signal is an DC signal, where the contribution from any signal that is not at the same frequency as the reference signal is attenuated essentially to zero, as well as the out-of-phase component of the signal that has the same frequency as the reference signal.

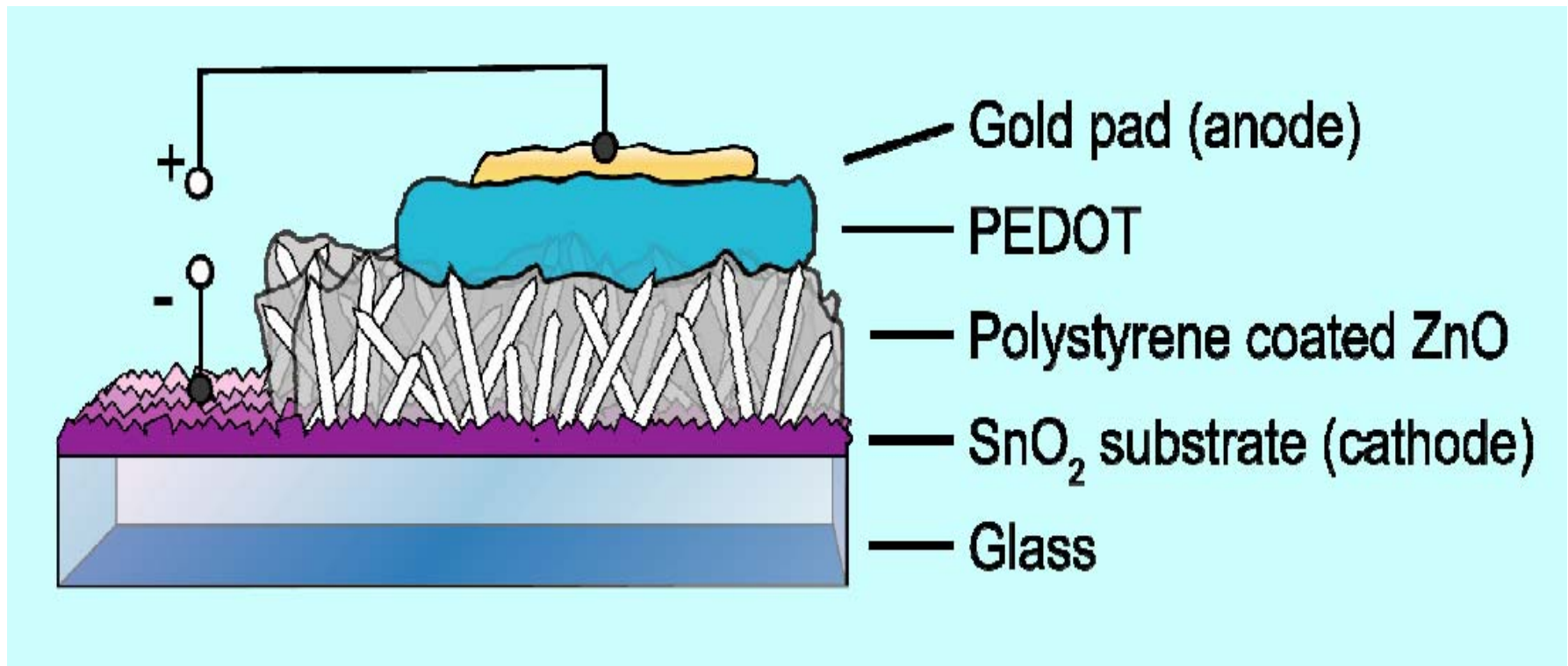


Light Emitting Diode



➤ Radiative recombination of electron-hole pairs injected into the semiconductor causes the emission of **photons**. This effect is called **electroluminescence**.

Our ZnO nanowires LED



Measurement Setup

- The IV measurements:
 - HP4145B semiconductor parameter analyzer in diode channel mode.
- EL spectra:
 - Ocean Optics spectrometer.

