

ECE 59500: Spring 2019  
Theory and Practice of Solar Cells: A Cell to System Perspective

**Lecture 4 Quiz:**

- 1) In the traditional, low-cost Si solar cell manufacturing process, which dominated until about 2010, what were the two things the aluminum back contact provided?
  - a) Electrical contact to the p-type base and a highly reflective mirror for incident photons.
  - b) Electrical contact to the p-type base and a heterojunction minority carrier mirror (from the Al that diffused into the Si and widened the bandgap).
  - c) Electrical contact to the p-type base and a P+P minority carrier mirror (from the Al that diffused into the Si and doped it P-type).
  - d) Electrical contact to the p-type base and better reliability than copper.
  - e) Improved photon recycling and lower contact resistance than copper.
  
- 2) What is a “learning curve” (also called an “experience curve”) for PV modules?
  - a) The continued increase in module efficiency as the total volume of shipments increases with time.
  - b) The continued increase in module reliability as the total volume of shipments increases with time.
  - c) The continued decrease in the number of solar cells per module as the total volume of shipments increases with time.
  - d) The continued decrease module cost as the total volume of shipments increases with time.
  - e) The continued decrease module manufacturing time as the total volume of shipments increases with time.
  
- 3) Which type of PV module has the highest efficiency at this time?
  - a) Those using crystalline Si PERC solar cells.
  - b) Those using multi-crystalline Si PERC solar cells.
  - c) Those using polycrystalline CdTe solar cells.
  - d) Those using crystalline Si IBC solar cells
  - e) Those using organic solar cells.

(OVER)

### ECE 59500 Lecture 4 Quiz (continued)

- 4) What is “photon recycling”?
- a) The multiple bounces from the front and back surfaces that an incident photon takes after it enters the solar cell.
  - b) The process of radiative recombination, followed by absorption of the emitted photon, which creates a new electron-hole pair, which then recombines and begins the process again.
  - c) The use of a single photon with energy greater than twice the bandgap to produce more than one electron-hole pair.
  - d) The use of two photons with energy greater than one-half of the bandgap to generate one electron-hole pair.
  - e) The process of making use of the photons reflected from the top surface of a solar cell in a second solar cell.
- 5) Consider a 3-junction, monolithic, series-connected tandem solar cell with  $E_{G1} < E_{G2} < E_{G3}$ . Beginning with the top cell, what order should we place these solar cells?
- a)  $E_{G1}, E_{G2}, E_{G3}$
  - b)  $E_{G3}, E_{G2}, E_{G1}$
  - c)  $E_{G1}, E_{G3}, E_{G2}$
  - d)  $E_{G2}, E_{G1}, E_{G3}$
  - e)  $E_{G2}, E_{G3}, E_{G1}$