PYV428/EPV450

Selected Topics in Nanotechnology

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Date: 10.05.2016

Duration: 2 hrs

Full marks: 40

Attempt all questions

Q1. A] Draw a neat schematic and of process steps of nanoimprint lithography (NIL) with a **brief description**. What is the advantage of NIL over photolithography technique?

B] For same tip and surface system two circular nanodots are fabricated. The dwell time for dot 1 is 4 times than that of dot 2. Compare the sizes of the dots. Draw pushing and sliding modes current profiles with STM **(no description)**.

[5+1+2+2=10]

Q2. A] Draw I-V characteristics of a PV solar cell in dark and illuminated condition and define **fill factor** and **efficiency** from that. In a schottky barrier type solar cell, why metal-insulator-semiconductor (MIS) interface is better than a metal-semiconductor (MS) interface? Give reason with **appropriate mathematical equation**.

B] Draw schematic of a solar cell with metal nanoparticle decoration at the top, illustrating how solar radiation is confined in the active medium. Why the radiation is confined? [4 + 2 + 4 =10]

Q3. A] Why a metal semiconductor junction is not practically useful as a base material for spintronic devices? How **diluted magnetic semiconductor** overcome this difficulty? What is the difference between **'carrier mediated exchange interaction and 'bound magnetic polaron'** models?

B] For **Magnetic-NM-Magnetic** ultrathin layer, show schematically the conduction of electron as per **'two resistor'** model for parallel and anti parallel cases and show that,

$$GMR = (r_- + r_+)^2 \;/\; 4r_+r_-$$ [5 + 5 =10]

Q4. A] Define **'chiral vector'** for a carbon nanotube. Based on this physical quantity, how CNTs can be classified in three groups?

B] Draw neat sketches of I-V characteristics of **electron field emission** and define 'threshold field. How F-N equation can be used to determine **'field enhancement factor'**? Large number of random nanotubes gives much less current than even few well separated nanotubes. Why? [4 + 2 +2 + 2 = 10]