

2016

Integrated Graduate School of Medicine, Engineering and Agricultural Science, Doctoral Course, University of Yamanashi

**Entrance Examination**No. 1/4

Course or Program	Special Doctoral Program for Green Energy Conversion Science and Technology	Subject	Materials engineering
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## Question 1

1-1 Draw schematic energy level alignment of the typical dye sensitized solar cell (DSSC) which is composed of  $\text{TiO}_2$ , dye, electrolyte and metal electrode.

1-2 Which is the absorption layer of DSSC in which light absorption produces electron-hole pairs?

1-3 Which is larger, the thickness of the dye layer or the dye's penetration depth,  $1/\alpha$ ? This is one of the disadvantages of DSSC. How is the disadvantage compensated for?

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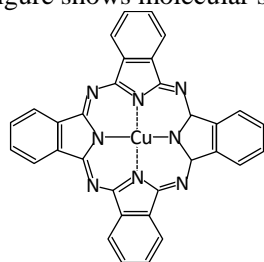
Entrance Examination

No. 2/4

Course or Program	Special Doctoral Program for Green Energy Conversion Science and Technology	Subject	Materials engineering
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Question 2

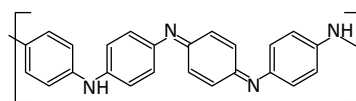
2-1 The figure shows molecular structures of typical organic molecules. Answer the name of them.



(a)



(b)

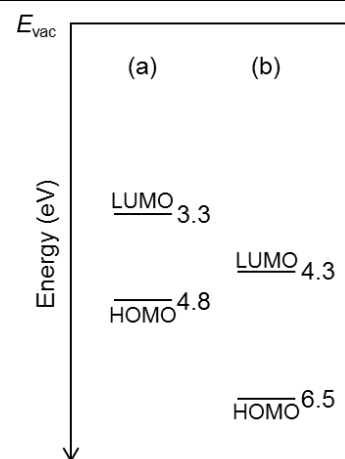


(c)

(a)	
(b)	
(c)	

2-2 The figure shows the energy level diagram of organic semiconductor of (a) and (b) in Q 2-1. One is an electron transport material and the other is a hole transport one. Answer mobile carrier type of (a) and (b), and describe the grounds.

	Carrier type	Ground
(a)		
(b)		



2-3 Describe the advantages and disadvantages of organic semiconductor devices.

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Question 3

For characterization of materials, electron or electromagnetic rays are often irradiated and resultant transmitted, emitted or reflected rays are measured. The following acronym list indicates abbreviated names of instrument which uses electron or electromagnetic rays. The table below means classification matrix. Answer the following questions.

Instrument acronym list : CL, EPMA, SEM, UPS, UV-VIS, XAFS, XPS

3-1. Please fill the table by the acronym to appropriate field. Some parts of field will be empty.

transmission or emission → irradiation↓	IR	VIS, UV	X-ray	electron
IR	FT-IR			
VIS, UV				
X-ray				
electron				

3-2. Pick up two instruments from the acronym list, and explain original meaning, mechanism, feature and applicable materials.

acronym (1) : ----- Explanation
acronym (2) : ----- Explanation

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## Question 4

Answer the following questions.

4-1. XRD and SAXS are similar technique. Generally, XRD pattern mainly composes of atomic or ionic arrangement information in a crystal structure, whereas SAXS curve includes nano texture in the samples. On the measurement of powder XRD patterns of  $\gamma$ -Mn (BCC structure), 110 and 200 diffraction peaks are observed at  $41.4^\circ$  and  $60.0^\circ$  in  $2\theta$ . Answer lattice parameter of  $\gamma$ -Mn and calculate diffraction angle ( $2\theta$ ) of 220 plane. Use  $\lambda = 0.154$  nm if necessary.

[lattice parameter]

[diffraction angle( $2\theta$ ) of 220 plane]

4-2. Explain differences between FT-IR and Raman spectroscopy, especially Infrared active and Raman active.