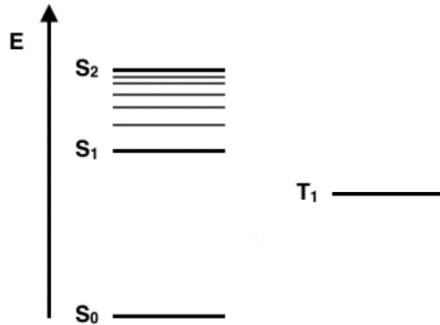


ELEC-E9210: EXAM (25 points) - 22.10.2020
(to be submitted before 10.30AM on MyCourses)

QUESTION 1: Optical Excitation in Organic Materials (3 points)

Indicate the main mechanism for optical excitation and the mechanisms for radiative decay, providing some key information (0.5 point/mechanism, 0.5 point/description)



QUESTION 2: Organic Field Effect Transistors (8 points):

a) Field-effect mobility of organic semiconductor depends on: (0.5 point/each, max 2 points)

b) Two OFETs with the same structure (including substrate, organic materials and dielectric), differs only for electrode geometry (OFET1: $L_1=25\mu\text{m}$, $W_1=1000\mu\text{m}$ and OFET2: $L_2=50\mu\text{m}$, $W_2=5000\mu\text{m}$). Which of the following applies?

- Saturation regime (1 points):
 - $I_{sat,1} > I_{sat,2}$
 - $I_{sat,1} = I_{sat,2}$
 - $I_{sat,1} < I_{sat,2}$

motivate your answer (1 points):

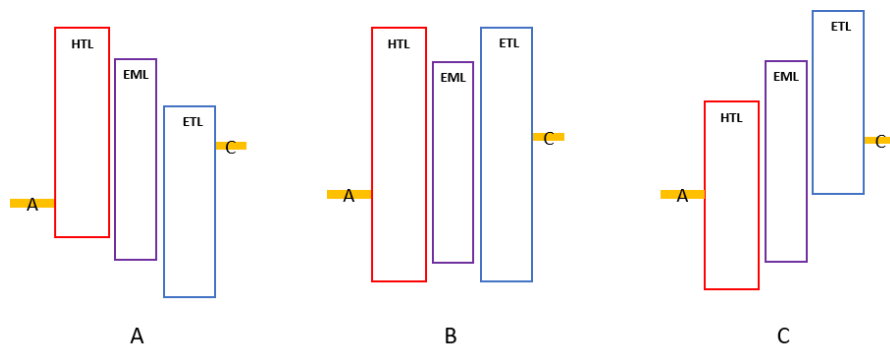
- Threshold Voltage (1 points):
 - $V_{th,1} > V_{th,2}$
 - $V_{th,1} = V_{th,2}$
 - $V_{th,1} < V_{th,2}$

motivate your answer (1 points):

c) What is the difference between *horizontal (classical)* and *vertical* organic field-effect transistor? Briefly comments on properties and differences (2 points)

• **QUESTION 3: OLED efficiency (2 points)**

Consider the energy diagram below for 3L OLED devices. Anode, cathode and emissive layer are the same. Based only on energetics, which HTL/EML combination is expected to lead to a more efficient device? Briefly explain why? (0.5point/answer, 1.5points for explanation)



• **QUESTION 4: Host-Guest system in emissive layer (5 points)**

a) Briefly explain the difference between *charge transfer* and *energy transfer* mechanism. Where does the exciton form? (2 points)

b) Based on materials HOMO-LUMO levels, for each host material determine a compatible guest(s). Briefly explain why (3 points)

COMBINATIONS			
	BCP	m-CP	Alq ₃
Ir(ppy) ₃			
Ir(piq) ₂ acac			
FIrpic			

host	HOMO (eV)	LUMO (eV)
BCP	-6.5	-2.8
m-CP	-5.7	-2.3
Alq ₃	-5.9	-3.1
guest	HOMO (eV)	LUMO (eV)
Ir(ppy) ₃	-5.6	-3
Ir(piq) ₂ acac	-5.2	-3.2
FIrpic	-5.8	-2.9

- **QUESTION 5: Organic Light Emitting Devices: Diode vs. Transistor (3 points)**

Briefly comments on the properties and differences between OLETs and OLEDs:

	OLET	OLED
electrode(s)		
what is the main charge transport mechanism		
where is light emission located?		

- **QUESTION 6: Organic Photovoltaics (4 points):**

a) Describe the photovoltaic effect in terms of exciton dynamics (2 points)

b) Briefly describe parameter/figure of merit of organic solar cell. Give a brief comment on why it is important in OPV (max 2 points)