**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):**

1. Field-effect mobility of organic semiconductor depends on: (0.5 point/each, max 2 points)
2. Two OFETs with the same structure (including substrate, organic materials and dielectric), differs only for electrode geometry (OFET1: L1=25µm, W1=1000µm and OFET2: L2=50µm, W2=5000µm). 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):

1. 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)**
1. Briefly explain the difference between *charge transfer* and *energy transfer* mechanism. Where does the exciton form? (2 points)

|  |  |  |
| --- | --- | --- |
| **host** | **HOMO** **(eV)** | **LUMO** **(eV)** |
| BCP | -6.5 | -2.8 |
| m-CP | -5.7 | -2.3 |
| Alq3 | -5.9 | -3.1 |
|  |
| **guest** | **HOMO** **(eV)** | **LUMO** **(eV)** |
| Ir(ppy)3 | -5.6 | -3 |
| Ir(piq)2acac | -5.2 | -3.2 |
| FIrpic | -5.8 | -2.9 |

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

|  |
| --- |
| **COMBINATIONS** |
|  | **BCP** | **m-CP** | **Alq3** |
| **Ir(ppy)3** |  |  |  |
| **Ir(piq)2acac** |  |  |  |
| **FIrpic** |  |  |  |

* **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):**
1. Describe the photovoltaic effect in terms of exciton dynamics (2 points)
2. Briefly describe parameter/figure of merit of organic solar cell. Give a brief comment on why it is important in OPV (max 2 points)