School of Engineering
Institute of Materials
Laboratory of Macromolecular
and Organic Materials

Organic Electronic Materials 2025 Exercise 6 (submit on 25.05.25)

1. Sketch graphs showing the density of occupied states with energy for a material at (i) 0 K, and (ii) at 300 K. Label the Fermi energy level in each graph. Why is the density of mobile charge carriers for intrinsic transport in a pure organic semiconductor *much* lower than for pure silicon?
2. Considering the data on the slide titled "Typical Electrode Materials and Organic Semiconductors" in 5.4:
   a. Which electrode material would you choose between gold and aluminum to get an injection into a layer of cyano-perylene derivative without resistance?
   b. Which carrier type is aluminum more prone to inject into a layer of rubrene (5,6,11,12-tetraphenyltetracene)?
3.
   a. Draw the energy diagram of a simple one-layer electron transport-only device, i.e. a layer of organic semiconductor sandwiched between two suitable electrodes. *Note: We consider that we cannot find electrodes that would lead to injection of electrons into the organic semiconductor without resistance.*
   b. Give the diffusion (or built-in) potential in the case where both electrodes are the same.
   c. In the former case of identical electrodes, draw the energy diagram of the device after application of a positive potential on the Fermi level of the right electrode. *Note: The Fermi level of the left electrode is fixed.*
   d. Considering the relation between gradient of potential and electric field, draw the electric field thus created, directly on your previous drawing.
   e. Give the expression of the force created by an electric field on an electron.
   f. From which electrode, left or right, would the electrons be injected into the organic semiconductor layer? Explain why.

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