

Final Exam (고급신소재실험 AMIE312-01/02, Fall 2014)

December 15, 2014. 12:00 pm – 12:50 pm

Prof. Youngmin You

1. List (as many as possible) the optical principles of polarizers. You don't need to explain the principles (2 points).

- ① dichroism ④ birefringence (각 0.5 point)
- ② reflection
- ③ scattering

2. The natural light is allowed to pass a linear polarizer and, subsequently, an analyzer, after which the light intensity is being monitored. The polarizer and analyzer are placed to be co-linear (i.e., to have an identical axis), and the latter can be rotated about the axis. It is observed that the light intensity experiences two maximum values during the 360 ° rotation of an analyzer (The Malus's law). Explain this behavior. Use a mathematical expression if necessary (3 points).

- polarizer과 analyzer 사이의 common axis에 대한 polarization 방향 111의 angle을 θ 라 하면, analyzer를 통과한 후의 linearly polarized light의 E-field E' 과 통과한 E 사이의 관계는

$$E' = E \cos \theta \quad +1$$

- Light intensity I 는 E-field의 amplitude E 의 제곱에 비례하므로 $I' = I \cos^2 \theta \quad +0.5$

$$I' = \frac{I}{2} (\cos 2\theta + 1) \quad +1$$

- $(\cos 2\theta + 1)$ 의 최대값은 2이며 이때 $\theta = 0, 180^\circ$ 이다 $\Rightarrow$ 2회 $+0.5$

3. Shown below is a polarized optical microscope image showing the characteristic Schlieren texture of nematic LCs. Explain why you see the texture (4 points).



- nematic LC는 birefringency를 가지며 $n_e > n_o$ 의 특성을

가진다. $+1$

- 따라서 beam의 extraordinary^{-ray}, ordinary-ray로 구분되어

LC 내를 propagation 할 때, 이 extraordinary-ray 와 ordinary-ray 간 interference를 한다. $+2$

- LC layer film의 thickness가 불균일하기 때문에 ^{lateral} 위치에 따라 constructive / destructive interference가 다르게 나타난다. $+1$

4. When you have a phosphorescent molecule with a 100% photoluminescence quantum yield, you can obtain an OLED with a 20% external quantum yield based on a glass substrate. In contrast, the external quantum yield is limited to 5%, if you employ a fluorescent molecule with a 100% photoluminescence quantum yield. Explain the origins of these limiting values (i.e., 20% vs 5%). The light out-coupling efficiency for the glass is 20% (4 points).

- hole-electron recombination 이) 의해 통계적으로 25% singlet exciton, 75%의 triplet exciton 이 발생한다. ($\chi_{\text{singlet}} = 0.25$, $\chi_{\text{triplet}} = 0.75$) +2
- 형광 device : $\eta_{\text{ext}} = \eta_{\text{int}} \eta_{\text{ph}} = \gamma \cdot \chi_{\text{singlet}} \cdot \eta_{\text{ph}} = 1 \times 0.25 \times 0.20 = 0.05$ (5%) +1
- 인광 device : $\eta_{\text{ext}} = \gamma \cdot (\chi_{\text{triplet}} + \chi_{\text{singlet}} \cdot \Phi_{\text{ISC}}) \cdot \eta_{\text{ph}}$
 $= 1 (0.75 + 0.25 \cdot 1) \cdot 0.20$
 $= 0.20$ (20%) +1

5. List the names of the teaching assistants (2 points).

한승호, 김기범, 서기원, 김기택, 최용락, 김영지

(총 한명 : 0.7 point
 두명 : 1.4 point
 세명 이상 : 2 point)