

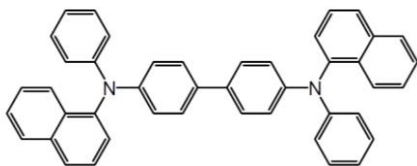
Absorbance measurements in accordance with various solvents

Keywords

Velox 1100 PDA UV-Vis Spectrophotometer, LuxPro software, NPB, Hexane, THF, Toluene, Acetonitrile

Introduction

Organic light-emitting diode (OLED) is light source which is used to create display panel. Its luminescent part is composed of organic compound, which can express wide range of color than other display components, so it is considered as "dream display." In the OLED module, N,N'-Bis(naphthalen-1-yl)-N,N'-bis(phenyl) benzidine (NPB) is used as raw material, which helps hole transport in OLED devices¹.



N,N'-Bis(naphthalen-1-yl)-N,N'-bis(phenyl)benzidine

The NPB can be dissolved in organic solvent such as tetrahydrofuran (THF). This solution absorb light strongly around 340 nm, so it can be analyzed by UV-Vis spectrophotometer. However, the spectrum could be shifted depend on the solvent. This is called solvatochromism, which is caused by interaction between solvent and solute due to the solvent polarity². If the wavelength is shifted to UV-direction, it is called hypsochromic shift (negative solvatochromism). On the other hands, if it is shifted to IR-direction, it is called bathochromic shift (positive solvatochromism).

In this experiment, the UV-Vis spectrum of NPB solution was analyzed with different solvents using Velox 1100 PDA UV-Vis spectrophotometer.

Reagent & Apparatus

- N,N'-Bis(naphthalen-1-yl)-N,N'-bis(phenyl)-benzidine (NPB; Sigma 556696)
- Hexane (Sigma 248878)
- Tetrahydrofuran (THF; Duksan A201251)
- Toluene (Sigma 155004)
- Acetonitrile (Sigma 110086)
- Velox 1100 PDA UV-Vis spectrophotometer
- LuxPro software

Procedure

1. Prepare NPB samples using hexane, THF, toluene and acetonitrile solvents. The concentration of each solution is 4 mg/L.
2. Load hexane to a cuvette and measure blank.
3. Wash the cuvette with prepared sample dissolved in hexane.
4. Load hexane dissolved sample to a cuvette and measure sample.
5. Wash the cuvette with other solvent.
6. Repeat procedure 2 to 5 with other prepared samples and solvents.

Results

Despite the same sample, spectrums were quite different depending on the solvent (Figure 1). Not only wavelength was shifted, but also the absorbance was changed. The NPB dissolved in toluene was absorbed light most among the samples, while that dissolved in hexane absorbed light least among the samples. In the case of NPB-hexane solution, it did not absorb most of incident light, which means that hexane masks the NPB excitation.

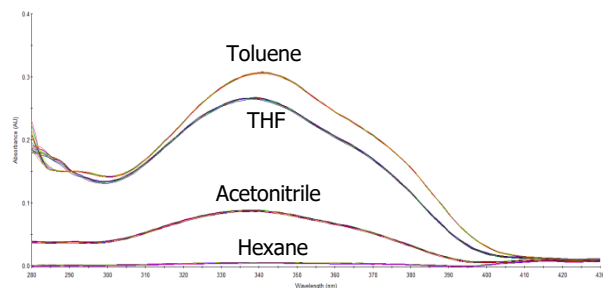


Figure 1. Spectra of NPB dissolved solutions

The peak wavelength was slightly shifted (Table 1). In the cases of THF, hexane, and acetonitrile, the peak wavelength is almost equal. However, when NPB is dissolved in toluene, the peak wavelength is highly shifted around 3 nm compared to dissolved in THF. It is because the dielectric constant is large if the solvent is strongly polar³. The dielectric constant was high in order of acetonitrile, THF, toluene, and hexane⁴. As following this order, the wavelength was red-shifted except hexane solvent of which absorbance was nearly zero.

Conclusion

The spectrum of NPB dissolved in various solvents were measured by Velox 1100 PDA UV-Vis Spectrophotometer. As a result, spectrums were plotted slightly different among the cases, which means that it is important to choose appropriate solvent depending on sample. From this experiment, it is concluded that the solvent effect can be discriminated by spectrophotometer, Velox 1100.

Table 1. Peak wavelength depend on solvent

Solvent	Peak (nm)	Absorbance
THF	337.7	0.2642
Toluene	340.5	0.3052
Hexane	337.7	0.0040
Acetonitrile	337.5	0.0874

References

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