Organic Light Emitting Diode predicate on the MEH / PPV: C_{60} Composite: Optical, Structural, as well as Electrical assessment

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Abstract:
Researchers investigated into the manner in which C60 affects the absorption, photoluminescence (PL), and luminescence of a single layer MEH / PPV: C_{60} organic light emitting diode. The particles of MEH/PPV have been incorporated with 5, 20, and 50% by weight of C60 in toluene. By spin-coating at 3000 rpm for 40s, a solution of MEH / PPV: C_{60} was put on ITO that had been cleaned. This made the emissive layer of the OLED. The UV/Vis/NIR spectrometer (Jasco V-570) as well as the luminescence spectrometer (Perkin Elmer LS50B) has been employed to measure the absorption and PL of the spin-cast films, correspondingly. We used a source measurement unit (SMU) (2400, Keithley Instrument) to find out about the current-voltage (I-V) features of OLED.

Keywords: Organic Light Emitting Diode, MEH/PPV, C_{60}, Spin Coating, Optical, PL, I-V.
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1. Introduction:

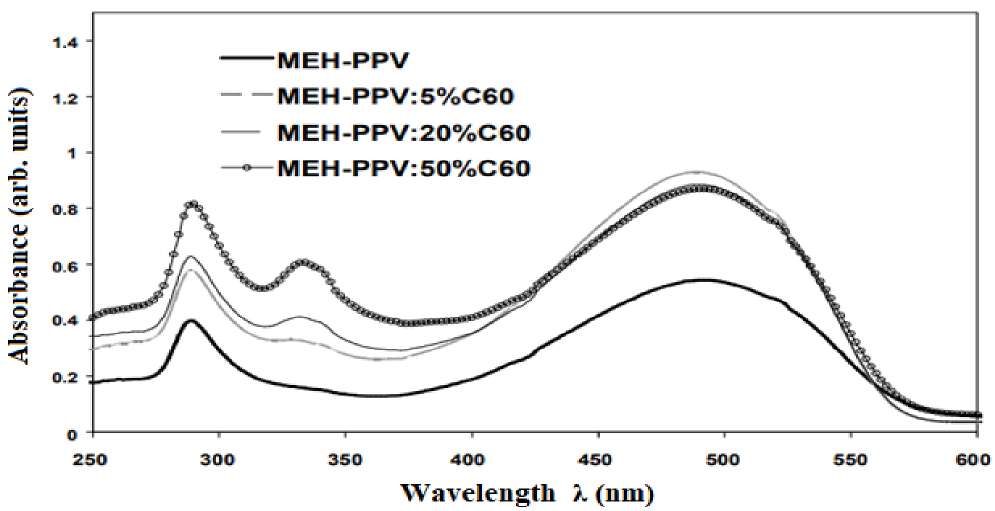
In recognition of his great technological and mechanical properties, fullerene (C_{60}) molecules are studied a lot as an electron acceptor with linked polymers in many electronic fields. Quantum rates can be increased by about 10% with polymer compounds that have fullerene molecules in them [1].MEH/PPV polymer continues to be widely utilized as the best conducting polymer for a variety of applications in optics, like organic-LED, sensors, as well as Non-chemical solar energy cells. It is stable in the environment, easy to control, and easy to make. Hetero-junction OLED of MEH/PPV: C_{60} showed that the conductivity improves by four orders of enormity when the volume snippet of C_{60} in a mixture is high. This is because the polymer forms conducting paths [2]. H.-S. Koo et al. [3] showed that adding a small amount of C_{60} to MEH/PPV can make OLEDs work better with a minimum amount of doping of 0.05% to 0.1%.The goal of this study is to find out how the number of C_{60} molecules affects how well MEH / PPV OLED works. First, we looked at the visual and structural features of the emissive layer in a thin film that was made by changing the percentage of C_{60} molecules in a hybrid made of MEH/PPV and C_{60}. We finished our study by figuring out how well an OLED gadget worked in terms of electricity.

2. Experimental Methods

For the preparation of a paste, 8mg of MEH/PPV powder was incorporated with 1ml of toluene.

The 8mg/ml of MEH/PPV solution was mixed with three different amounts of fullerene (C60): 5%, 20%, and 50% wt%. The single layer OLED device was made by spinning the solution at 3000 rpm for 40s on an ITO plate with a resistance of 30/m^2. First, the ITO surfaces were cleaned with ultra sonification along with a solution designed for cleaning. Then, they were cleaned with acetone, isopropyl alcohol, and de-ionized water. Then, they were dried by flushing them down with nitrogen gas along with putting them in a warm oven (under 60^{oC}). The aluminum top electrode was put on the single layer by heating evaporating it in a vacuum at a pressure of 10-5 mbar. After the sample was ready, it was checked without any more work. A UV / Vis / NIR analyzer (Jasco V-570) was used to measure the thin films' optical absorption spectra. The luminescence analyzer (Perkin Elmer, LS50B) was used to measure the photoluminescence emission (PL) spectra of spin-cast thin films. The FTIR spectra were taken with Perkin-Elmer System 2000 FTIR spectrometer in transmission mode, These current-voltage characteristics of the devices were measured using a Keithley 2400 source evaluating equipment.

3. Discussion and results



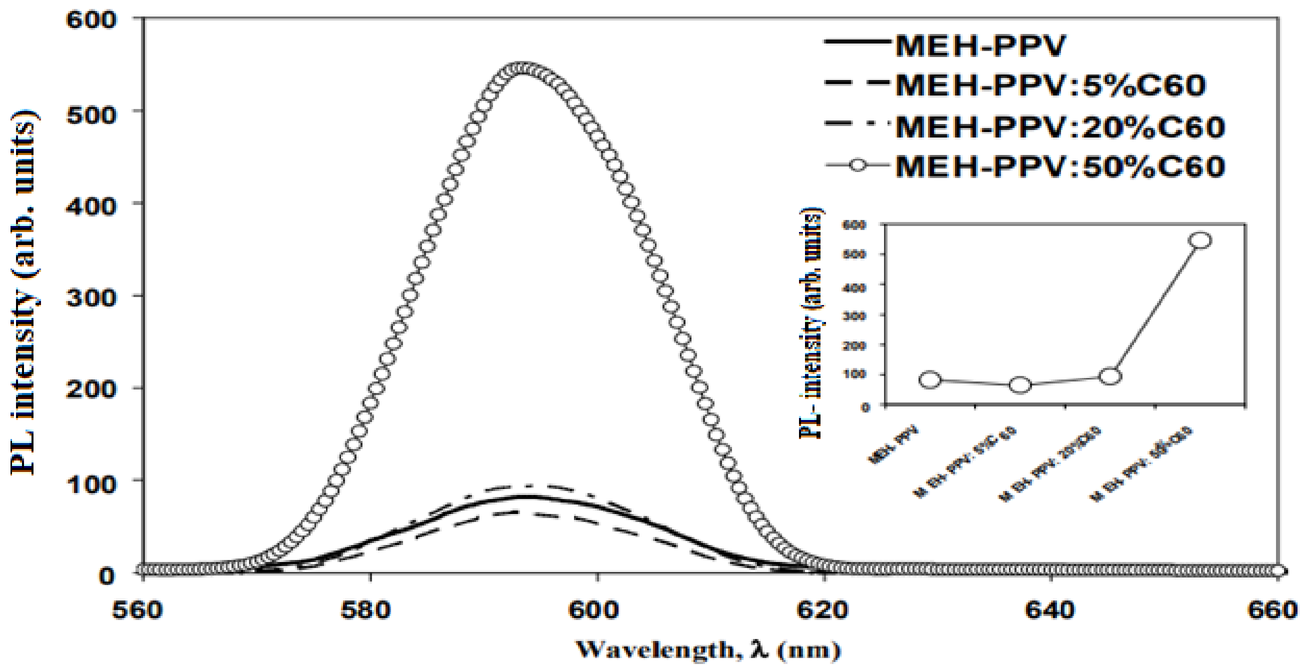


Figure 1: Optic absorption spectra **(a)** and PL gamuts **(b)** of MEH/PPV and MEH/PPV/C_{60} composites (5%, 20%, and 50% wt% of C_{60}).

Figure 1(a) demonstrates the absorption spectra of MEH/PPV and the MEH/PPV: C_{60} combination (5%, 20%, and 50% wt% of C_{60}). Most of the time, the characteristic peak of pure C_{60} (at 288 nm) and intrinsic MEH/PPV film (at 332 nm) overlap. The π-π* absorption apex of MEH/PPV is capable of being seen unambiguously at approximately 500 nm for both sterling MEH/PPV and MEH/PPV: C_{60} hybrid films. This is the same as what A. Ltaief et al. [4] reported. With the addition of C_{60}, rate of uptake goes up by a lot. But as the wt% of C_{60} in the MEH / PPV: C_{60} mixture goes up, the rate of absorption goes down. Another big change happens at 288nm, where the characteristic peak of C_{60} in the UV range gets bigger as the amount of C_{60} in the mixture goes up. These data show that the C_{60} molecules improved the OLED's ability to absorb energy in the high-energy range. This made the OLED brighter. At an excitation line of 486nm, Figure 1(b) appearance the photoluminescence (PL) gamuts of MEH / PPV and MEH / PPV : C_{60} amalgamation with different amounts of C60. For MEH/PPV, the PL pinnacle can be found between 570 and 620 nm [5]. With a high concentration of C_{60}, these peaks are much stronger in MEH/PPV: C_{60} hybrid films. The relationship between the PL intensity at a wavelength emission of 593 nm and the concentration of fullerene (shown in the inset of Figure 1(b) shows that the minimum value of C_{60} is at 5 wt.%. Above this concentration, the PL strength goes up a lot, which means that there are a lot more of them, and the OLED starts to work less well.

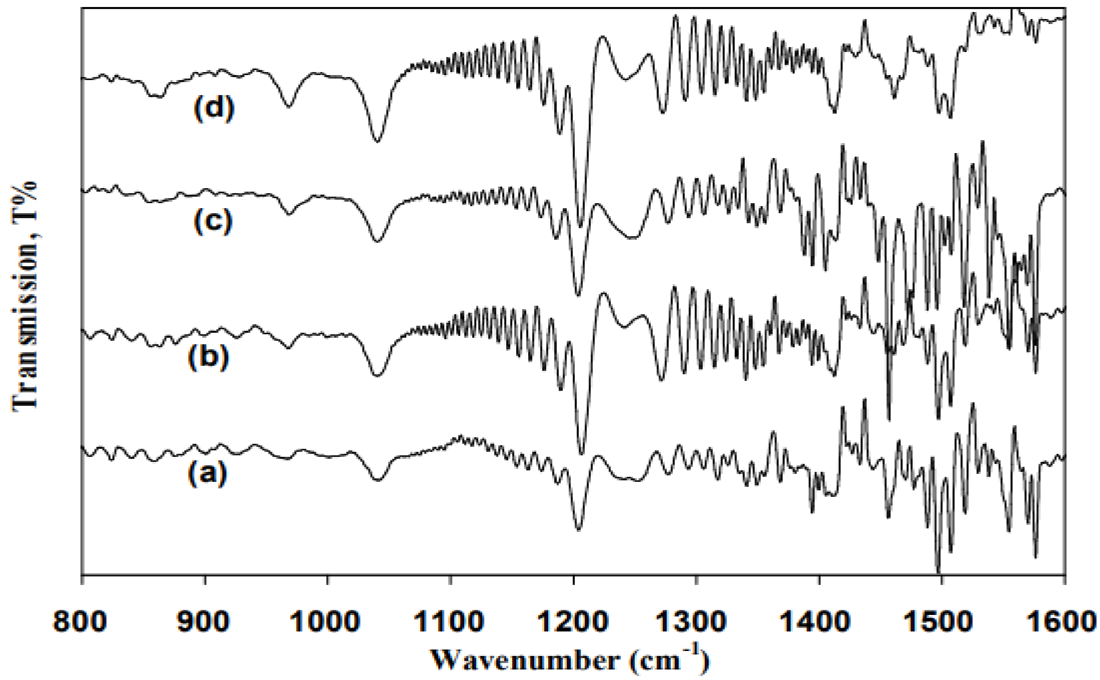


Figure 2: the infrared spectrum for (a) sterling MEH/PPV and (b) MEH/PPV:C_{60} composites with (b) 5%, (c) 20%, and (c) 50% wt% of C_{60}.

Figure 2 exhibits the infrared spectra of sterling MEH/PPV as well as MEH/PPV: C_{60} mixtures. Substantial peaks were seen at 850, 965, 1040, and 1205 cm^{-1}. These variables correspond to out-of-plane phenyl C-H wagging, trans-double bond C-H wagging (vinyl group), symmetrical and asymmetrical C (aromatic)-O-C elongation methods, separately. The transmission coefficients for MEH/PPV: C_{60} composites at 1040 and 1205cm^{-1} are lower than those of MEH/PPV. This suggests that as the percentage of C_{60} in composites goes up, the phenyl rings become more parallel to the plane of the substrate. Changes in the tests' transmission peaks show that C_{60} can influence the manner in which the polymer chains in MEH/PPV are aligned and shaped.

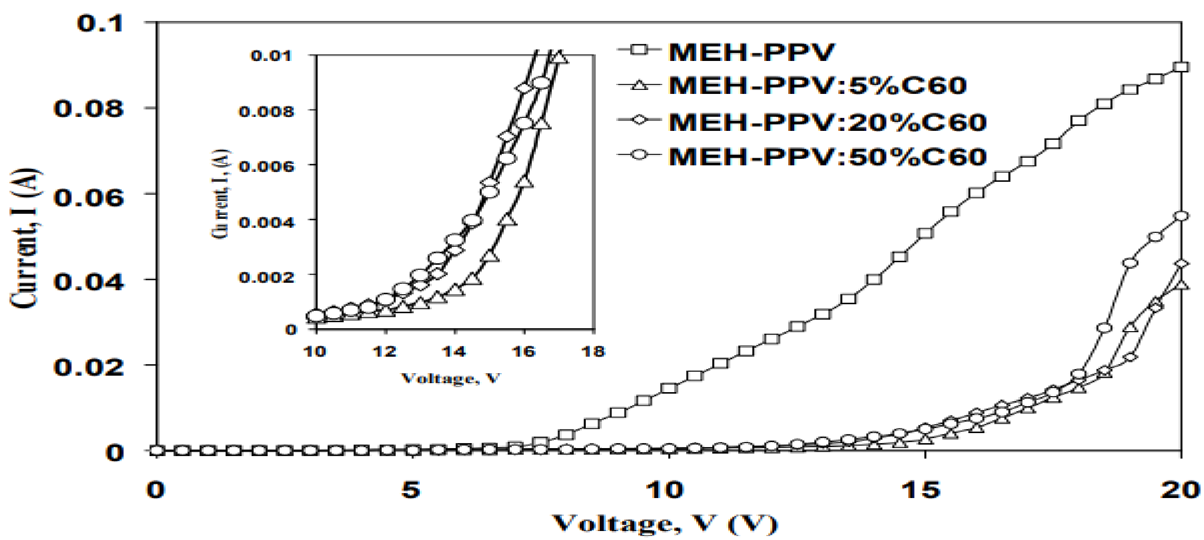


Figure 3: The I-V features of an OLED made from a 5%, 20%, and 50% mixture of MEH/PPV and MEH/PPV/C_{60}. In the inset, the I-V properties of MEH/PPV: C_{60} mixtures with different amounts of C_{60} are demonstrated.

At ambient temperature, the third figure illustrates the I-V features of a single-layer OLED made from MEH/PPV and MEH/PPV: C_{60} hybrids with different weight percentages of C_{60}. Pure MEH/PPV has a very low turn-on voltage of 7.5V according to its I-V graph. These I-V graphs show that C_{60} molecules make the voltage needed to turn on these devices higher. The figure 4's inset shows that as the amount of C_{60} in the MEH/PPV: C_{60} mixture goes up [6] the knee voltage goes down.

Conclusion

In the present investigation, we as a species discovered that a drop in PL strength caused by a 5% increase in C_{60} content led to a proliferation of large assemblages at the cost of smaller ones. This allowed MEH/PPV domains to form between the large aggregates without being disrupted. When C_{60} clusters are spread out in a more random way, the PL reaction goes up even more, which can be seen at concentrations higher than 20%. Lastly, because C_{60} molecules stick together more, the OLED knee voltage goes up.

Reference

[1] J.J.M. Halls and K. Piechler, Appl. Phys. Letters 68, 3120 (1996).

[2] A. Ltaief and A. Bouazizi, Synthetic Metals 147, 261–266 (2004).

[3] H.S. Koo and M. Chen, Diamond and Related Materials 16, 1162-1166 (2007).

[4] A. Ltaief and J. Davenas, Materials Science and Engineering C 25, 67–75 (2005).

[5] H. Jin and Y. Hou, Solar Energy Materials & Solar Cells 93, 289–294 (2009).

[6] S. kumar Y. et.al Dogo Rangsang Research Journal 11, 12, 2347-7180(2021)