High resolution patterning of polyfluorene derivative containing photo cross-linkable oxetane units

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Abstract

We have synthesized a photo patternable blue light-emitting polyfluorene (PF) derivative containing cross-linkable oxetane units. Poly(9,9-bis-(4-octyloxy-phenyl)-fluorene-2,7-diyl-alt-9,9-bis-((3-hexyloxy-3'-ethyl)-oxetane)-fluorene-2,7-diyl) has been synthesized by Suzuki coupling polymerization. The relationship between patterning property and several variables such as the intensity of the exposed UV light, the concentrations of additives, has been studied by using optical microscope UV/visible spectroscopy, photoluminescence and scanning electron microscope (SEM). We obtained fine patterns with 10 μm resolution using the polymer film after exposure and development. This patterning method using conjugated polymers can be applicable to make fine pixels for PLEDs and OFETs.

1. Introduction

Multi-color OLEDs have been successfully fabricated by vacuum deposition of small electroluminescent molecules, but solution processing of larger molecules (electroluminescent polymers) would result in a cheaper and simpler manufacturing process. However, it has proved difficult to combine the solution processing approach with the high-resolution patterning techniques required to produce a pixellated display. Therefore, much attention has especially been focused on the techniques of photopatterning for conjugated polymer the chemical amplified photolithographic method.

2. Results

We synthesized polyfluorene derivative containing photo cross-linkable oxetane unit by Suzuki coupling polymerization. The structure of the polymer is shown in figure 1. The synthesized polymer was soluble in common organic solvents such a THF, chloroform and toluene. The synthesized polymer dissolved in p-xylene and then mixed 2% photoacid generator (PAG). The solution was spin-coated onto the glass substrate. The thickness of the coated polymer film is about 600A. The polymer film was exposed by using Hg arc lamp for various times through the shadow mask in inert gas atmosphere. Afterward, to further advance the crosslinking process in the growing network, the films were annealed at 150°C for 10min. Sequentially, the unexposed region was developed by THF and the exposed region polymer networks were found to be insoluble in any common solvent.

Figure 2 shows the UV-vis absorption spectra and PL emission spectra of the developed thin films. Although polymer films were exposed by Hg arc lamp, UV-vis absorption and PL emission spectra did not change during irradiation. The results for the polymer properties were summarized in Table 1.

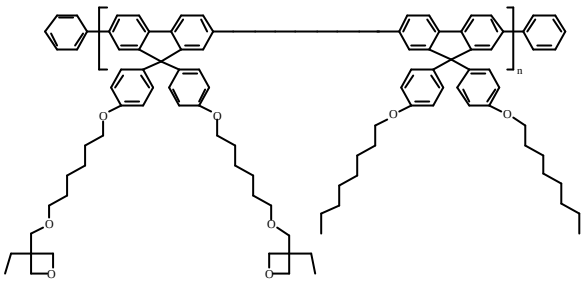

Fig 1. The structure of the polymer containing photo-crosslinkable functional group.

Table 1. Summary of the properties of the polyhmer

	Mn ($x10^3$)	Mw ($x10^3$)	DPI	Tg (°C)	UV max (nm)	PL max (nm)
Polymer	22	35.2	1.6	130	385	422

Figure 3 shows photographs of photo-patterning polymer after patterning process on silicon wafer substrate after patterning process. For obtaining high resolution pattern, we used contact alinger.. **We obtained fine patterns with 10 μm resolution using the polymer film after exposure and development.**

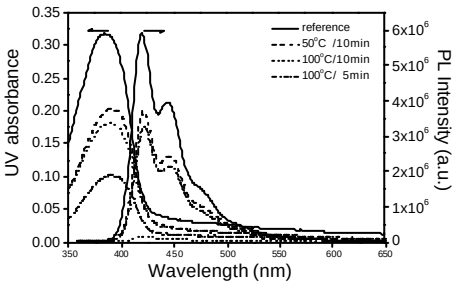

Fig 2. Optical properties of irradiated polymer fimls.

Fig 3. Photographs of the polymer thin film after the photolithography process on silicon wafer.

3. Conslusion

We have patterned conjugated polymer using the photoacid generator-based photolithographic method and have successfully patterned with 10μm resolution. The result was confirmed with microscope analysis of patterned film. This patterning method using conjugated polymers can be applicable to make fine pixels for PLEDs and OTFTs.

Refernces

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