

Synthesis and Characterization of Light-Emitting Polymer Microfibers using Porous Silicon

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The fabrication and characterization of micro and nanostructures based on porous templates have attracted great interest due to their significant potential applications such as chemical and biological sensors, electron emitting flat panel displays, and other electronic and photonic devices [1]. The deposition of specific materials, such as polymers and non-linear materials, into porous templates allows tailoring structures as inverse replicas of the porous [2]. In this context, we have used a technique for the fabrication of polymer microfibers made of Poly[(9,9-dioctylfluorenyl-2,7-diyl)-co-bithiophene] (F8T2) and Poly[2-methoxy-5-(3',7'-dimethyloctyloxy)-1,4-phenylenevinylene] (MDMO-PPV) by infiltration into the pores of macroporous silicon.

Templates were prepared by electrochemical etching of the p-type silicon with a resistivity of 10-20 Ωcm in a home-made electrochemical cell containing a mixed solution of HF:DMF (1:10) at room temperature with current density of 10 mA/cm^2 for 10 min. The size of the pore was controlled by the current density and the etching time [3]. F8T2 and MDMO-PPV were selected as photoluminescent conductive polymers. The combination of their conductivity and intense photoluminescence results in light emitting polymer (LEP) used for applications in flat panel displays. Polymeric microfibers were obtained by infiltration of the polymer solution in tetrahydrofuran (THF) at room temperature into the pores of the silicon followed by immersion into 40 wt% KOH(aq) at 40°C. All samples were inspected by using an environmental scanning electron microscopy (ESEM, FEI Quanta 600).

Figure 1 shows F8T2 and MDMO-PPV microfibers with heights about 6.5 μm and a diameter value of 1 μm . The intensity-normalized absorption and photoluminescence (PL) spectra of a solution of polymer in THF, a film of polymer and polymer microfibers on glass are compared in figure 2. For the F8T2, the film absorption and emission bands are red-shifted compared to the solution as a result of electronic perturbations due to π -stacking of polymer chains in the solid [4]. The emission spectra of the F8T2 microfibers and the F8T2 film are similar with the emission maximum at 541 nm. For the MDMO-PPV, the film absorption band is also red-shifted with regard to the solution 455 nm. This result agrees with previous works [5]. The emission spectra of the microfibers and the film are different to the MDMO-PPV solution. The emission band in the solid state reveal two emission peaks centred at 581 nm and 630 nm which are red-shifted respect to the solution polymer where the maximum is centred at 547 nm.

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Figures:

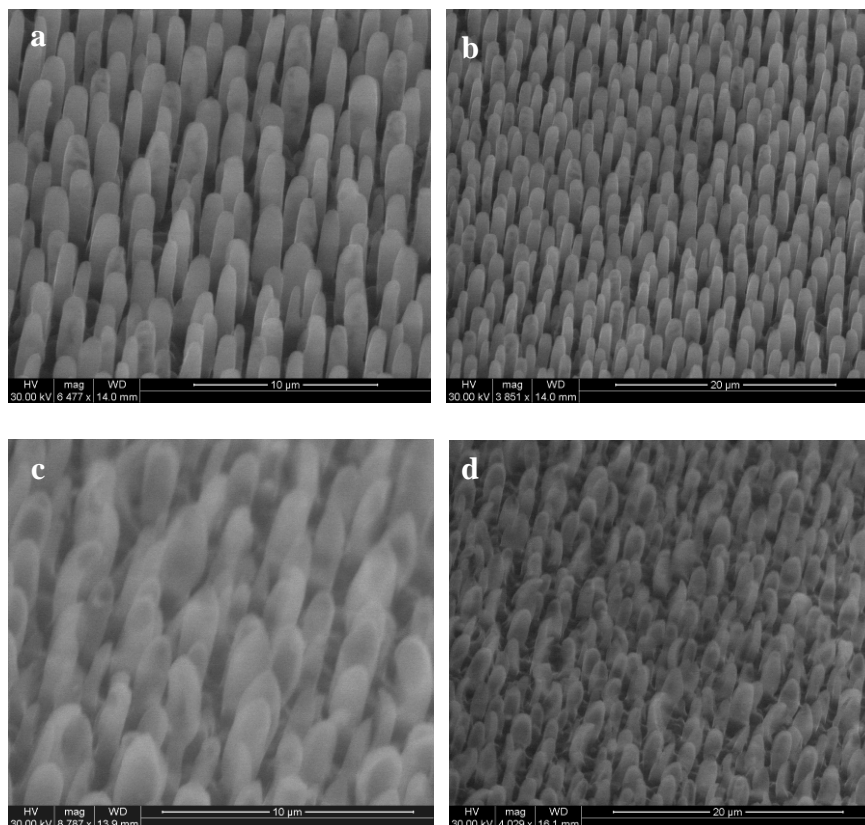


Figure 1. ESEM images of F8T2 microfibers (a, b) and MDMO-PPV microfibers (c, d) after removed the porous silicon template.

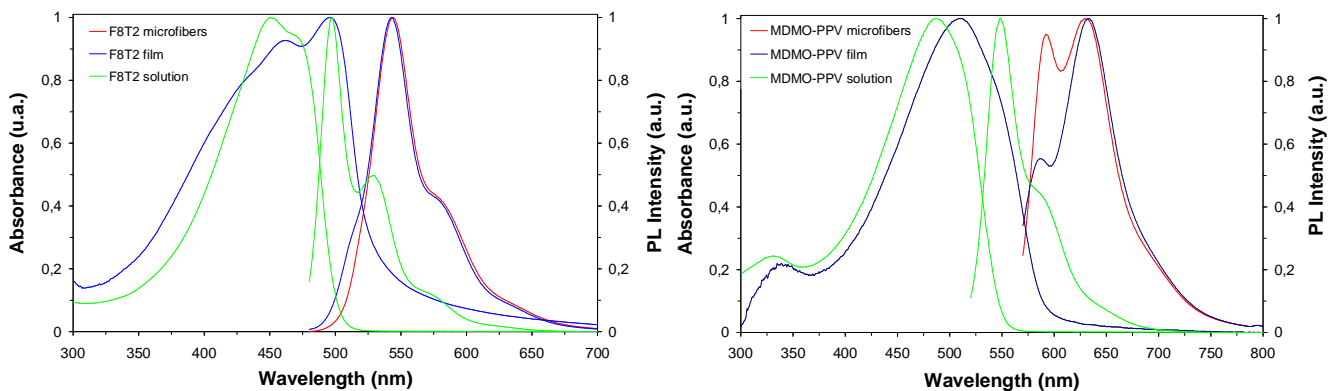


Figure 2. UV-Visible absorption and PL emission spectra of F8T2 and MDMO-PPV for a) solution in THF, b) films and c) microfibers.