INTISARI

Fiber Mikro Polimer-MBBA Sejajar sebagai Fiber Fungsional yang Responsif Secara Optik

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Telah dilakukan penelitian tentang pembuatan dan analisis sifat fisis terhadap fiber mikro polimer-MBBA sejajar dengan molekul kristal cair nematik di dalam inti (*core*) fiber. Fiber mikro polimer-MBBA dielektrospining menggunakan bahan utama yakni polyvinylpyrrolidone (PVP) sebagai polimer dan N-(4-methoxybenzylidene)-4-butylaniline (MBBA) sebagai kristal cair. Penelitian ini menghasilkan fiber mikro yang memiliki kemampuan respon secara optik terhadap stimulasi. Molekul MBBA berhasil terdeposisi di sepanjang fiber memberikan fenomena optik yang unik, yakni karakteristik optiknya bergantung arah orientasi fiber dan stimulan suhu yang diberikan. Optimalisasi morfologi fiber dapat dicapai dengan konsentrasi PVP dalam kisaran 15 wt% sampai 20 wt% dan rasio konsentrasi larutan PVP-MBBA adalah 1/3, 2/3 dan 3/3 gram. Fiber mikro polimer-MBBA sejajar yang dihasilkan memiliki diameter di bawah 10 μm. Semakin besar konsentrasi PVP maka semakin kecil diameter fiber dan intensitas cahaya yang ditransmisikan oleh fiber, sedangkan parameter keteraturan molekul kristal cair semakin tinggi.

Uji termal-optik menunjukkan bahwa dengan semakin meningkatnya suhu sampel dari suhu ruang atau kondisi nematik, intensitas cahaya yang ditransmisikan fiber semakin menurun secara perlahan hingga mengalami pola gelap pada saat mencapai suhu fase isotropik. Suhu transisi fase nematik ke isotropik (T_{NI}) fiber yang didapatkan berada kisaran 1 ºC hingga 3 ºC di bawah T_{NI} MBBA murni. Semakin besar konsentrasi MBBA maka T_{NI} fiber semakin tinggi. Sementara hubungan terbalik antara MBBA dan T_{NI} terjadi pada fase isotropik; konsentrasi MBBA yang rendah menyebabkan pelebaran rentang suhu dan waktu respon. Uji FTIR menunjukkan bahwa molekul MBBA terbentuk secara terpisah dari rantai PVP di dalam fiber.

Kata Kunci: Kristal cair nematik, fiber mikro polimer-kristal cair, fiber sejajar, fiber responsif, elektrospining, transisi fase

ABSTRACT

Aligned Polymer-MBBA Microfibers as Optically Responsive Fibers

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This study discusses the fabrication and physical properties of aligned polymer-MBBA with nematic liquid crystal molecules at their core. The polymer-MBBA microfibers were electrospun from a solution of polyvinylpyrrolidone (PVP) and N-(4-methoxybenzylidene)-4-butylaniline (MBBA). This study has successfully fabricated microfibers that can respond optically to external stimuli. MBBA molecules that were deposited along the fibers exhibited a unique optical phenomenon, i.e. its optical properties depended on the direction of the fiber and the given stimuli. To optimize the fiber morphology, several concentrations of PVP were used: 15 wt%, 17 wt% and 20 wt%, and PVP-MBBA solution with 1/3, 2/3 and 3/3 MBBA/PVP weight ratios. Aligned polymer-MBBA microfibers have diameter under 10 μm. An increase in PVP concentration decreased the diameter of fibers and the transmitted light intensity of fibers, while the order parameter of MBBA molecules were increased.

The thermal-optical characterization showed that the rise of fiber's temperature from room temperature to nematic phase temperature, resulted a slowly decrease in the transmitted light intensity of fibers, until the fibers became completely dark at isotropic phase temperature. The nematic-isotropic temperature (T_{NI}) of polymer-MBBA microfibers shifted 1 ºC–3 ºC lower from the T_{NI} of pure MBBA. The higher MBBA concentration, the higher T_{NI} of polymer-MBBA microfibers. Meanwhile, a reverse correlation between MBBA concentrations and phase transition was found in the isotropic phase; a significant increase in temperature rate and response time was occurred with small weightage of MBBA. FTIR measurement confirmed that the liquid crystal molecules were self-phase separated from the PVP chains in the fibers.

Keywords: Nematic liquid crystal, responsive fibers, liquid crystal microfibers, aligned microfibers, phase transition, electrospinning