

**SYNTHESIS AND CHARACTERIZATION OF
POLYACRYLONITRILE (PAN) NANOFIBERS REINFORCED
WITH CNT AND CNF PREPARED VIA ELECTROSPINNING
TECHNIQUE**

RUBIA BINTI IDRIS

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UNIVERSITI MALAYSIA SABAH

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ABSTRACT

PAN electrospun nanofiber reinforced with and without nanomaterials were produced via electrospinning technique. The PAN polymer was dissolved in *N, N* dimethylformamide solvent with ratio 10% w/w of PAN to DMF. Four parameters were studied; working distance (5, 10, 15 cm), applied voltage (10, 12.5 and 15 kV), types of nanomaterials (CNT and CNF) and ratio of nanomaterials were used (2 to 10 w/w %). Then, the optimised parameter was used to produce the PAN/mixture CNT-CNF with assumed that the PAN fibers were produced will have a fine fibers diameter with high thermal stability and high conductivity. The morphologies study was carried out by using Scanning Electron Microscopy (SEM), thermal stability was investigated by using Thermal Conductivity Analyzer (TGA) and Differential Scanning Calorimeter (DSC). While, the electro-conductivity properties of the PAN fiber were determined by using Impedance Analyzer (IA). From the studies, it was revealed that the PAN electrospun reinforced with mixture of CNT and CNF (ratio 5:3 and 5:5) show a highest electric-conductivity properties (4.8×10^{-4}) with small fibers diameter (0.60-0.68 μm) and high thermal stability (60 - 65%).

ABSTRAK

PAN serat nano diperkukuh dengan dan tanpa bahan nano dihasilkan melalui teknik *electrospinning*. Polimer PAN dilarutkan di dalam pelarut *N, N dimetilformamid* dengan nisbah 10% w/w PAN terhadap DMF. Empat parameter telah dikaji; jarak kerja (5, 10, 15 cm), tenaga voltan yang digunakan (10, 12.5 dan 15 kV), jenis nanobahan (CNT dan CNF) dan nisbah nanobahan yang digunakan (2 hingga 10 w/w %). Kemudian, parameter yang telah dioptimumkan, digunakan untuk menghasilkan PAN/campuran CNT-CNF dengan mengandaikan bahawa gentian PAN dihasilkan akan mempunyai diameter gentian yang halus dengan kestabilan haba yang tinggi dan kekonduksian elektrik yang tinggi. Kajian morfologi telah dijalankan dengan menggunakan kaedah Imbasan Elektron Mikroskop (SEM), kestabilan terma telah dikaji dengan menggunakan terma kekonduksian-elektrik analisis (TGA) dan kalorimetri pengimbas pembezaan (DSC). Manakala, sifat konduktiviti serat nano PAN ditentukan dengan menggunakan *Impedance Analyzer* (IA). Daripada kajian ini, didapati bahawa serat nano PAN diperkukuhkan dengan campuran CNT dan CNF (nisbah 5:03 dan 5:5) menunjukkan sifat kekonduksian-elektrik yang tinggi (4.8×10^{-4}) dengan diameter serat nano yang halus ($0.60 - 0.68\mu\text{m}$) dan mempunyai kestabilan haba yang tinggi (60 - 65%).