INTISARI

Penelitian ini mengkaji performa komposit polimer *thermoplastic polyurethane* (TPU) dengan penambahan *filler* konduktif berupa grafit, *carbon nanotube*, dan grafena nanoplatelet (GNP) pada fraksi berat 4 wt% untuk aplikasi 3D *printing* berbasis *Fused Filament Fabrication* (FFF). Fokus penelitian adalah membandingkan respons listrik dan mekanik dari masing-masing jenis *filler* serta mengevaluasi pengaruh proses ekstrusi terhadap kinerja akhir material.

Proses penelitian diawali dengan pembuatan komposit melalui metode *solution casting* berbantuan pelarut N,N-Dimethylformamide (DMF) untuk membantu proses dispersi *filler* dalam matriks TPU. Material yang telah dipersiapkan kemudian diproses melalui ekstrusi untuk menghasilkan filamen, yang selanjutnya digunakan dalam proses pencetakan spesimen menggunakan metode FFF. Karakterisasi dilakukan melalui pengujian tarik, pengujian siklik, dan pengukuran resistansi statik untuk mengevaluasi sifat mekanik, respons elektromekanik, serta kestabilan konduktivitas material pada setiap tahapan fabrikasi.

Hasil penelitian menunjukkan adanya perbedaan performa elektromekanik antar jenis *filler* yang dipengaruhi oleh perbedaan struktur, morfologi, serta kemampuan filler dalam membentuk dan mempertahankan jaringan konduktif di dalam matriks TPU. Hasil penelitian ini diharapkan dapat menjadi dasar dalam menentukan jenis *filler* yang paling sesuai untuk menghasilkan komposit TPU konduktif dengan kombinasi sifat mekanik dan kestabilan listrik yang optimal untuk aplikasi fungsional berbasis manufaktur aditif.

Kata kunci : komposit, grafit, *filler*, *carbon nanotube*, grafena nanoplatelet, *Fused Filament Fabrication*, manufaktur aditif

ABSTRACT

This study investigates the performance of thermoplastic polyurethane (TPU) polymer composites incorporating conductive fillers, namely graphite, *carbon nanotube*, and graphene nanoplatelets, at a filler loading of 4 wt% for Fused Filament Fabrication (FFF)-based 3D printing applications. The study focuses on comparing the electrical and mechanical responses of each filler type and evaluating the effect of the extrusion process on the final material performance.

The research process began with the preparation of the composites using a solution casting method assisted by N,N-Dimethylformamide (DMF) as a solvent to facilitate filler dispersion within the TPU matrix. The prepared materials were subsequently processed through extrusion to produce filaments, which were then used to fabricate test specimens using the FFF method. Characterization was performed through tensile testing, cyclic testing, and static resistance measurements to evaluate the mechanical properties, electromechanical response, and conductivity stability of the materials at each stage of fabrication.

The results demonstrated differences in the electromechanical performance among the filler types, which were influenced by variations in their structure, morphology, and ability to form and maintain conductive networks within the TPU matrix. This study is expected to provide a basis for determining the most suitable filler for producing conductive TPU composites with an optimal combination of mechanical properties and electrical stability for functional applications based on additive manufacturing.

Keywords : polymer composites, graphite, carbon nanotube, graphene nanoplatelets, Fused Filamen Fabrication, additive manufacturing