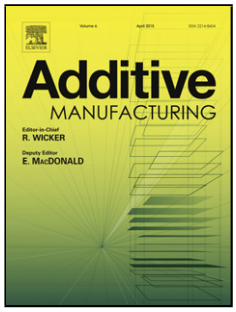

Title: Embedded electrical tracks in 3D printed objects by fused filament fabrication of highly conductive composites

Authors: J.C. Tan, H.Y. Low

PII: S2214-8604(18)30248-3
DOI: https://doi.org/10.1016/j.addma.2018.06.009
Reference: ADDMA 423

To appear in:

Received date: 23-4-2018
Revised date: 11-6-2018
Accepted date: 12-6-2018

Please cite this article as: Tan JC, Low HY, Embedded electrical tracks in 3D printed objects by fused filament fabrication of highly conductive composites, *Additive Manufacturing* (2018), https://doi.org/10.1016/j.addma.2018.06.009

Embedded electrical tracks in 3D printed objects by fused filament fabrication of highly conductive composites

Authors: J. C. Tan, H. Y. Low *

Engineering Product Development Pillar, Digital Manufacturing and Design Centre (DManD)

Singapore University of Technology and Design,

8 Somapah Road, Singapore 487372

***Corresponding Author** Email: hongyee_low@sutd.edu.sg

Abstract

The incorporation of electrical components into 3D printed products such as sensors or printing of circuits requires the use of 3D printable conductive materials. However, most conductive materials available for fused filament fabrication (FFF) have conductivities of less than 1000 S/m. Here, we describe the study of conductive thermoplastic composites comprising either nylon – 6 or polyethylene (PE) matrix. The fillers used were nickel and Sn95Ag4Cu1, a low melting point metal alloy. The combination of nickel metal particles and tin alloy allows for higher metal loading at lower melt viscosity, compared to composites of nickel metal particles alone. Conductivities of 31000 S/m were achieved, and 30 vol. % metal loading was processable by a single screw extruder. Embedded conductive tracks of various geometries were easily printed via FFF. Electrical conductivity of embedded conductive track has been investigated as a function of geometrical variation, where conductive tracks printed along a horizontal axis show resistance of ≤ 1 Ω. Porosity of the printed track is shown to increase with prints along the vertical axis, leading to a reduction in electrical conductivity of more than two orders of magnitude.

Keywords

Additive manufacturing
Fused filament fabrication
3D printing
Electronics
Conductive filament