Mechanical Engineering Thesis Defense

Study Thermal Property of Stereolithography 3D Printed Multiwalled Carbon Nanotubes Filled Polymer Nanocomposite

School for Engineering of Matter, Transport and Energy

Kunal Gide

Advisor: Dr. Qiong Nian

Abstract

Traditionally, for applications that require heat transfer (e.g. heat exchangers),metals have been the go-to material for manufacturers because of their high thermal aswell as structural properties. However, metals have some notable drawbacks. They arenot corrosion-resistant, offer no freedom of design, have a high cost of production, andsourcing the material itself. Even though polymers on their own don't show greatprospects in the field of thermal applications, their composites perform better than theircounterparts. Nanofillers, when added to a polymer matrix not only increase theirstructural strength but also their thermal performance. This work aims to tackle two ofthose problems by using the additive manufacturing method, stereolithography to solvethe problem of design freedom, and the use of polymer nanocomposite material forcorrosion-resistance and increase their overall thermal performance. In this work, fourdifferent concentrations of polymer composite materials were studied: 0.25 wt%, 0.5wt%, and 1wt% for their thermal conductivity. The samples were prepared bymagnetically stirring them for a period of 10 to 36 hours depending on theirconcentrations and then sonicating in an ice bath further for a period of 3 to 12 hours.These samples were then tested for their thermal conductivities using a Hot Disk TPS2500S. Scanning Electron Microscope (SEM) to study the dispersion of the nanoparticlesin the matrix. Different theoretical models were studied and used to compareexperimental data to the predicted values of effective thermal conductivity. An increaseof 7.9 % in thermal conductivity of the composite material was recorded for just 1 wt%addition of multiwalled carbon nanotubes (MWCNTs).

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