BIOGRAPHICAL SKETCH

Mahdi Mohammadizadeh was born on 1987 in Iran and grew up in Tehran, the capital city. He graduated with his Bachelor of Science degree in Polymer Engineering from Tehran Science and Research University in Iran. He also received his Master of Science degree in Polymer Engineering from Sahand University of Technology. Then, he came to Tennessee Tech University to work in the 3D Printing Lab and pursue his Ph.D. in Engineering with an area of focus in Mechanical Engineering. He has published more than 12 journal articles in prestigious journals in the fields of organic electronics, polymer processing, composite materials, and additive manufacturing.

EDUCATION

Ph.D. Engineering
Tennessee Tech University, 2017-2020 (expected)

M.S. Polymer Engineering
Shand University of Technology, 2010-2012

B.S. Polymer Engineering
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College of Engineering

TENNESSEE TECH

The Department of

Mechanical Engineering

Announces the Dissertation Defense

of

Mahdi Mohammadizadeh

In Partial Fulfillment of the Requirements

For the degree of

Doctor of Philosophy in Engineering

March 23, 2020 at 8:00 a.m.

Zoom Link: https://tntech.zoom.us/j/5706264721

Held in

Brown Hall Room 241

Tennessee Tech University

FIELD OF STUDY

Mechanical Engineering

DISSERTATION TOPIC

Mechanical and Thermal Analysis of Automotive Components Manufactured with 3D-printed Continuous Fiber Reinforced Thermoplastic Polymers

EXAMINING COMMITTEE

Dr. Ismail Fidan (Chairperson)

Dr. Mohan Rao (Mechanical Engineering)

Dr. Michael Allen (Mechanics)

Dr. Ahmad Vaselbehagh (Mechanical Engineering)

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ABSTRACT

In this dissertation, a comprehensive study is conducted on mechanical, thermal and structural properties of Continuous Fiber Reinforced Additively Manufactured (CFRAM) components. CFRAM components are lightweight, yet strong materials with a wide range of potential applications in the automotive industry, aerospace, sports goods, and medical tools. The wide range of applications of these novel materials justifies the need to study their mechanical and thermal properties. CFRAM parts are lightweight compared with metals, have strong mechanical properties, have easy process, and short manufacturing time. In addition, thermoplastic polymers used for CFRAM components make the products recyclable. In this study, fiber reinforced composite specimens were printed using a commercially available printer and their mechanical, thermal and structural properties were investigated. Nylon and onyx were used as the matrix and Carbon fiber (CF), fiberglass (FG), and Kevlar were used as reinforcing agents. Mechanical and thermal analyses include tensile analysis, creep analysis, Dynamic Mechanical Analysis (DMA), Thermogravimetric analysis (TGA), thermal conductivity, heat capacity, and heat diffusion. Also, the effect of fiber type, fiber content, infill density, infill pattern, matrix type, layer thickness, printing orientation, and temperatures on thermomechanical properties were investigated. Microstructural analysis was conducted to investigate the fracture mechanism, internal morphology, interlayer adhesion, and the printing quality of specimens. For this aim, optical microscope and SEM analysis were used. The analytical and statistical analyses were conducted to study tensile strength, elastic modulus, and creep properties of CFRAM components. The rule of mixture was used to study the tensile properties, and the linear regression analysis was used to analyze the creep properties. Finally, the applicability of CFRAM components for fabricating automotive parts was examined. For this aim, ease of design and manufacturing, final price, and production time as three important manufacturing factors were considered. Three car parts including thermostat housing, oil breather cap, and timing cover were printed and their properties were compared with metal parts produced with traditional methods.