UAEU جامعة الإمارات العربية المتحدة United Arab Emirates University

The College of Graduate Studies and the College of Engineering Cordially Invite You to a

Master Thesis Defense

Entitled

EFFECT OF FE3O4 NANOPARTICLES ON PERFORMANCE OF SHAPE MEMORY POLYMERS FOAM USING SOLID STATE FOAMING PROCESS

by

Tamem SalahAlDeen Salah

Faculty Advisor

Dr. Aiman Ziout, Mechanical Engineering Department

College of Engineering

Date & Venue

Monday, 23 December 2019 (12:00-14:00)

Room 040, F3 Building

Abstract

The scope of this research is the emerging class of smart materials namely stimulus-responsive shape memory polymers (SMP) that can be actuated on-demand to recover their original shape, after being quasi-plastically distorted. SMP are ideal for an integrated intelligent system, in which the structure is heated to a certain temperature to generate reactive motion as pre-programmed.

This research aims to employ a new emerging method for generating foam structure; called solid-state foaming. The generated foamed structures are advantageous over fully dense SMP in terms of the low density, high compressibility, and high deformations when they recover their permanent shape. However, the mechanical properties of these samples is reduced due to the existence of pores.

In this research, effects of polymer type, nanoparticle percentage, packing pressure, holding time, foaming temperature and foaming time parameters were tested. Two levels were selected for each factor. A Taguchi design was selected to determine number of experiments needed to be conducted. Post to foaming of the samples, their performance namely foaming ratio, shape recovery speed and actuation load were evaluated. Further characterization techniques namely Differential Scanning Calorimetry (DSC), Fourier Transformation Infrared Spectroscopy (FTIR) and X-ray Diffraction (XRD) were operated on the samples in their original form to obtain better knowledge of their structure and chemical composition.

The experimental results showed that temperature has no impact on the actuation load, as long as a temperature above glass transition temperature is applied. Addition of nano-particles caused the shape recovery speed to reduce; due to creation of discontinuity within the polymer matrix. However, higher foaming ratio was obtained when NPs were introduced to the polymer structure.

Keywords: Shape Memory Effect, Shape Memory Polymer, Epoxy Foam, Nano Composites, Iron Oxide Nanoparticles, Fillers.