An Investigation of the Mechanical Properties of PMMA-based Composites Reinforced with PZT Ternary Nanoparticles

Mohammed Taha Yaseen[1], Mohammed A.M. Al Saadi[2], Abbas I. Hussein[3], W. Bdaiwi[4*]

Abstract

This study investigated the effects of Nano Lead Zirconium Titanium (PZT) on the mechanical properties of poly (methyl methacrylate) (PMMA) using tensile and compression tests, three-point bending, fracture toughness tests, and hardness tests. The results revealed that the addition of PZT has promising effects on the composite, except with respect to elongation, which deteriorated with the addition of PZT. The results show clearly that PZT has a significant effect on PMMA quality.

Key Words: PZT, PMMA, Three-point Bending, Fracture Toughness, Polymer Nano Composites.

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Introduction

Poly (methyl methacrylate) (PMMA) is one of the most popular polymers used in the polymer composites industries. Polymers are materials with large (macromolecule) molecules, and consist of repeating units that are typically connected by covalent bonds. The type of bond by which these molecules are bonded together is normally a hydrogen bond (Buthaina A. Ibrahim, 2010). The composites can be prepared from polymers with a variety of special fillers, common reinforcements, and modifiers to produce specific properties that have a wide range of applications (Dong et al., 2011). Polymer blends are materials consisting of two or more polymers that have been mixed together to yield a material with new characteristics (A., 1984, Michele et al., 2008). Polymers are commercially important because of a number of valuable structural features they possess, such as high ductility, high mechanical strength, high melting points, a very high resistance to dissolving in solvents, abrasion and fatigue (ASKELAND).

The amount of energy that a material can absorb before it breaks is called the material toughness (Ahmed, 2009). PMMA has many attractive properties, such as: it is lightweight, it has a high transmittance, it is transparency, it is highly resistant to chemicals, it has good insulating properties, and it is highly resistant to corrosion from weathering. Reinforcing PMMA can improve its resistance to fracture, as well as the stiffness of the polymer (Askeland and Phule). Reinforced PMMA was chosen for all these positive effects, as well as for other beneficial properties, including its low cost, toughness, strength and resistance to dissolving.

Corresponding author: W. Bdaiwi

Address: [1]Department of Physics, College of Education for Pure Science, University of Anbar, Iraq; [2]Department of Communication & Computer Engineering, Cihan University - Erbil, Kurdistan Region-Iraq; [3]Department of Prosthodontics Dental Material, College of dentistry, University of Anbar, Iraq. [4*]Department of Physics, College of Education for Pure Science, University of Anbar, Iraq.

[4*]E-mail: wdbedeawy@yahoo.com

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