Iranian Journal of Materials Science & Engineering Vol. 8, Number 2, Spring 2011

MECHANICAL PROPERTIES OF DENTAL COMPOSITE MATERIALS REINFORCED WITH MICRO AND NANO-SIZE Al_2O_3 FILLER PARTICLES

F. Foroutan[1], J. Javadpour[1], A. khavandi[1], M. Atai[2] and H. R. Rezaie[1]

* *javadpourj@iust.ac.ir*

Received: December 2010 **Accepted: March 2011**

[1] School of Metallurgy and Materials Engineering, Iran University of Science & Technology, Tehran-Iran.
[2] Iran Polymers and Petrochemical Institute, Tehran-Iran.

Abstract: *Composite specimens were prepared by dispersion of various amounts of nano-sized Al_2O_3 fillers in a monomer system containing 60% Bis-GMA and 40% TEGDMA. For comparative purposes, composite samples containing micrometer size Al_2O_3 fillers were also prepared following the same procedure. The mechanical properties of the light- cured samples were assessed by three-point flexural strength, diametral tensile strength, and microhardness tests. The results indicated a more than hundred percent increase in the flexural strength and nearly an eighty percent increase in the diametral tensile strength values in the samples containing nano-size Al_2O_3 filler particles. It is interesting to note that, this improvement was observed at a much lower nano-size filler content. Fracture surfaces analyzed by scanning electron microscopy, indicated a brittle type of fracture in both sets of specimens.*

Keywords: *Composites, Polymers, Ceramics, Mechanical Properties*

1. INTRODUCTION

A dental composite material typically consists of a resin-based matrix, a photo initiator system, and a high percentage of inorganic filler. Dimethacrylate (DMA) monomer such as the visible light cured 2, 2'-bis- [4-(methacryloxy propoxy) -phenyl] -propane (Bis-GMA) is used as photo activated monomer in most common dental composites [1-2]. Usually, a low molecular weight diluent monomer such as tri (ethylene glycol) dimethacrylate (TEGDMA) is added to thin the highly viscous Bis-GMA monomer and to achieve a consistency suitable for the incorporation of fillers [3-4]. The ideal restorative material should be identical to the natural tooth structure, both in appearance, and strength. Although the composite materials based on Bis-GMA have become vital for dental restorations due to their superior aesthetic quality, they experience a considerable mechanical challenge during function. Thus, improving the mechanical properties is one of the most important research tasks in this field. In recent years, the use of reinforcing inorganic fillers in various forms has been a major approach towards the development of improved dental composites [5,6]. In general, the size, shape, amount, and hardness of the filler material, the nature and quality of the bond between the filler and the polymer matrix, and the distribution of filler particles in the polymer matrix all have an influence on the wear and mechanical properties of the composite resins [7-14]. Perhaps one of the most noticeable advances in composite filler technology has been the incorporation of fillers in the nanometer scale [15-19]. One potential advantage of nanoparticles is the improvement in the optical properties of the epoxy resin composite because their diameter is a fraction of the wavelength of visible light resulting in the inability of the human eye to detect the particles. In addition, the high surface area associated with nanoparticles provides more interfacial interactions and improved properties in the composite samples [16-17, 20]. The positive effect of nano-sized silica and silicate-based fillers on flexural strength, surface hardness, fracture toughness, and optical properties has already been reported in the literature [15,17,19,21]. In view of the importance of the size of the fillers, the main purpose of this study was to determine the effect of nano-sized Al_2O_3 particles as reinforcing filler, on the mechanical properties of dental composite samples.