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Basic Properties of PMMA Reinforced Using Ceramics Particles of ZrO_2-Al_2O_3-SiO_2 Coated with Two Types of Coupling Agents

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Abstract. In this study, novel composites materials composed of polymethyl methacrylate (PMMA) reinforced ZrO_2-Al_2O_3-SiO_2 filler system were developed. Zirconia-alumina-silica filler system were synthesized through sol-gel technique. Chitosan and trimethoxypropilsilane (TMPS) were used to modify the composites system. The resulting composites material were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD) and hardness test. SEM images displayed the composites particles in nanometer size with minor agglomeration. The XRD results revealed the presence of cubic and tetragonal phase of zirconia and also monoclinic silica phases in the composites system. These crystallographic characteristic could affect the mechanical properties of the composites. The hardness value for un-modified composites was 15.27 ± 0.25 VHN and for TMPS 19.43 ± 1.89 VHN and chitosan modification 18.75 ± 2.05 VHN, respectively. Therefore, these novel composites materials composed of PMMA reinforced filler system of zirconia-alumina-silica would provide the potential to apply in dental technology.

Introduction

Fixed partial dentures including jacket crown and bridges were commonly prepare from dental porcelain or porcelain-fused to metal. Recently, the development of ceramic nanoparticles as a part of the component in dental materials has gaining interest. The ceramics materials exhibit ideal properties including esthetics, its thermal expansion similar coefficient as tooth structure, good biological and mechanical properties. Restorations process fabricated indirectly in a dental laboratory often require time-consuming procedures, several expensive equipments and highly trained technicians. Several weeks are taken for completion the restorations so that provisional (interim) or temporary restorations must be provided [1]. The provisional crown serves both pulpal and periodontal protection, stabilization of tooth position and maintenance mastication function [2].

Composites is defined as a system that contains two or more distinct constituent or phases. In respect to the dental composite, composites might refer to the filler reinforced polymer matrix materials that commonly used as restorative materials. One of the fillers function is to increase the mechanical properties [3,4]. Recently, the filler particles used are varies in term of chemical composition, morphology and dimensions. One of the most promising filler is silica (SiO_2) which is commonly used due to its excellent mechanical properties and translucency properties. Another type