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Hardness Evaluation of Dental Composite with Ceramic Fillers

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Abstract. In this study, new dental composites materials were developed. The two composites systems composed of zirconia (ZrO_2), alumina (Al_2O_3) and silica (SiO_2) (composites A) and zirconia (ZrO_2), calcium (CaO), and silica (SiO_2) (composites B) were synthesized through sol-gel method. These two systems were combined with urethane dimethacrylate and tetraethylene glycol dimethacrylate with 1% chitosan as coupling agent to build up the dental composites material. The resulting composites were subject to evaluation by microvickers hardness test and X-ray diffraction. The microvickers hardness test revealed that the hardness value for composites A and B were 24.48 and 21.9 VHN, respectively. Furthermore, the data were submitted to t-test (α=0,01) and it showed t count of both samples was 0,871 which means between the $-t_{1-½\alpha} < t < t_{1-½\alpha}$ thus showing statistically the same average hardness value of both samples. Eventually, the new dental composites could be anticipated to apply in dental composites filler. The hardness results support the XRD result revealed that tetragonal crystal phase will help the transformation toughening mechanism and cubical crystal phase of zirconium dioxide. Both of the crystal phases were formed to stabilize the zirconia.

Introduction

Dental composites materials have been develop as a restorative materials that could be used in biological tissue in term of appearance and functions [1]. The main components which developed the properties and characteristics of composites i.e polymerizable resin, filler, and the filler-resin interface [1]. Filler materials have several functions including enhancing modulus, hardness, strength and also translucency. Recently strontium glass, barium glass, quartz, borosilicate glass, ceramic, and silica particles have been as filler particles [2,3,4,5]. These fillers materials will affect to the resultant properties and characteristics of composites resin [6].

Zirconia is a crystalline dioxide of zirconium. The development of zirconia as ceramic material has increased along with the development of the dentistry technology and the need of material that required a high strength and aesthetic appearance. The other benefit is to avoid the use of certain metals that generally cause allergies in an effort toward metal-free dentistry [7,8]. The mechanical properties of zirconia are similar to those of metals (stainless steel). This particles also could protect the structure against crack propagation. Recently, the development of the combination of zirconia with other elements as raw materials in dentistry become gaining interest [9]. The addition of the other minerals will make tetragonal form more stable and be more effective in inhibit and seals crack propagation, Started in the late of 1980s, ceramic engineers learned to stabilize the tetragonal form of zirconium oxide at room temperature by adding small amounts (3–8 mass %) of calcium.

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