
Influence of ZrO₂ on thermal and mechanical properties of glasses

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Abstract

In the field of medical applications, biocompatible and bioactive glass-ceramics have been developed. It can be differed between two types of materials depending on the medical use. The first type are materials used for implantology as medical protheses, the second type covers materials used for dentistry regarding restoration.

Glass-ceramics are manufactured by processing glasses under a controlled heat treatment. Lithium-silicate composition glass-ceramics were found to be interesting for dental applications.

One of the first glass compositions used for dental application was the Li₂O–ZnO–SiO₂ system. Since then, various compositions had been figured out, resulting in compositions with lithium-disilicate (Li₂Si₂O₅) as a base glass to be found as a very promising material as of high strength, great chemical durability and most importantly the similar appearance to natural teeth.

The compositions based on lithium-disilicate were multicomponent compositions consisting of at least six different elements. Evaluations on glasses with Li₂O/SiO₂ ratios other than lithium-disilicate had been made in recent history, one of it analysing the SiO₂–Li₂O–P₂O₅–ZrO₂ glass system.

The aim of this work was to study the influence of ZrO₂ on lithium silicate glasses.

Lithium silicate glasses in the system 1Li₂O:1.7SiO₂ as a base glass with the addition of 0, 1, 2, 4, 6 and 8 mol % ZrO₂ have been synthesized by melt-quenching techniques and analysed regarding the effect of ZrO₂ on thermal, mechanical and chemical as well as structural properties of the glass. Raman, DSC, density measurements and hardness tests were carried out.

The studies reveal that the ZrO₂ addition causes network polymerization. The hardness of glass is increasing with the addition of ZrO₂ and the glass forming ability is improved.

Keywords: biomedical, glass strength, hardness, Raman, DSC, density

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