

Influence of different CaF₂ contents and heat treatment temperature on apatite-mullite glass ceramics derived from waste materials

ABSTRACT

An apatite-mullite glass ceramics composition derived from clam shell (CS) and soda lime silicate (SLS) glass has been fabricated from a heat treatment process of composition $[x\text{CaF}_2 \cdot (45-x)\text{SLS} \cdot 15\text{CS} \cdot 20\text{Al}_2\text{O}_3 \cdot 20\text{P}_2\text{O}_5]$, where x is 5, 10, 15 and 20 (wt. %). The result concluded that the Ca and Si elements were found in the CS and SLS glass respectively as a major weight composition, thereby promoting the use of waste materials in the manufacture of glass ceramic samples. Besides, the CaF₂ addition lowers the glass transition temperature (T_g) and crystallisation temperature (T_c) of the glass composition. The density and percentage of the linear shrinkage of the samples differs with the addition of CaF₂ and various heat treatment temperatures. For the structural properties' analysis, the formation of fluorapatite with a needle-like microstructure and mullite phase was enhanced with a higher CaF₂ content, while the growth of the anorthite phase was observed to occur at a higher heat treatment temperature. Generally, the addition of a high CaF₂ content with the help of heat treatment in apatitemullite glass ceramics composition greatly promotes the crystallisation of the fluorapatite phase, which is crucial for denture glass ceramics.

Keyword: Apatite-mullite glass ceramics; CaF₂; Clam shell; Heat treatment; Soda lime silicate glass