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Influence of Microstructural Effect on Microvickers Hardness Properties of SiO_2-Na_2O-CaO (SNC) Waste Based Glass-ceramic

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Abstract. There are a lot of waste materials consist of silicate based such as coal combustion ash, slag from steel production, fly ash, mud, as well as glass cullet or mixtures to produce glass-ceramics. This research work using clam shell (CS) ash and soda-lime-silica (SLS) waste glass powder for fabricating novel SiO_2-Na_2O-CaO (SNC) glass-ceramic. The samples were composed of SLS (50%), Na_2CO_3 (30%), and CS (20%) in weight percentage via conventional melt-quenching technique and solid-state sintering technique. The samples were investigated via X-Ray Diffractometer (XRD), Field emission microscope (FESEM), and microvickers hardness tester. The samples were sintered at 550-950 °C to investigate the influence of microstructural effect on microvickers hardness properties at applied force 0.5 and 1.0 kgf. The optimal Vickers hardness properties at sintering temperature 850 °C due to high crystallization of SiO_2 phase from the residual glass and CaO content enhanced the viscosity flow, high compactness of particles arrangement and densification of sample.

1. Introduction

Glass-ceramics are composite materials consist of combination of residual amorphous phase and crystalline phase. Since the glass-ceramic is used in a large scale application, the materials technology is evolving rapidly. In this study, the mechanical properties of polycrystalline SNC glass-ceramic were determined by phase crystallization and microstructural properties at different sintering temperature. Generally, the mechanical properties of SNC system are less studied by previous researchers. The mechanical behaviour on evolving microstructure of the parent glass with fully crystallized phase have been explained and compared in previous published paper [1-3]. The crystal size plays an important role in preventing the propagation of the cracks in the structure of silicate glass-ceramics with fine