

## Effects of heat treatment temperature on the formation and stability of $\text{Na}_2\text{Ca}_2\text{Si}_3\text{O}_9$ crystalline phase: Advanced bioactive glass-ceramic for potential tissue engineering application

Md Enamul Hoque<sup>3</sup>, Anika Benozir Asha<sup>1</sup>, Manzila Islam Tuheen<sup>1</sup> and Mehedi Hasan<sup>2</sup>

<sup>1</sup>Department of Materials and Metallurgical Engineering, Bangladesh University of Engineering and Technology, Bangladesh

<sup>2</sup>Department of Glass and Ceramic Engineering, Bangladesh University of Engineering and Technology, Bangladesh

<sup>3</sup>Department of Biomedical Engineering, King Faisal University, Kingdom of Saudi Arabia

Recently, the  $\text{SiO}_2$ - $\text{CaO}$ - $\text{Na}_2\text{O}$ - $\text{P}_2\text{O}_5$  bioactive glass-ceramic system has shown high potential in tissue engineering applications due to its excellent biocompatibility, mechanical properties and remarkable bonding features with living tissues. This work focused on the synthesis of bioactive  $\text{Na}_2\text{Ca}_2\text{Si}_3\text{O}_9$  crystalline phase along with amorphous phase by conventional solid-state reaction route. 50%  $\text{SiO}_2$ , 23%  $\text{CaO}$ , 24%  $\text{Na}_2\text{O}$  and 3%  $\text{P}_2\text{O}_5$  powders were mixed and heat-treated under oxidizing environment at 800-1000°C for about 10 hours to attain the required structure. The X-ray diffraction (XRD) and Fourier transforms infrared spectroscopy (FTIR) were employed to investigate the effects of heat treatment temperature on the formation and stability of the  $\text{Na}_2\text{Ca}_2\text{Si}_3\text{O}_9$  crystal phase. The resulting phase morphology was further examined by the field emission scanning electron microscopy (FESEM). The XRD, FTIR and FESEM studies confirmed the formation of glassy phase above 950°C. However, it was observed that phosphorous rich silicorhenanite phase ( $\text{Na}_2\text{Ca}_4(\text{PO}_4)_2\text{SiO}_4$ ) decreased with increasing heat treatment temperature which might have great effect on bioactivity.

**Keywords:** Bioactive; Glass-ceramic;  $\text{SiO}_2$ - $\text{CaO}$ - $\text{Na}_2\text{O}$ - $\text{P}_2\text{O}_5$ ; Solid state reaction;  $\text{Na}_2\text{Ca}_2\text{Si}_3\text{O}_9$  crystal