Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

SUPPORTING INFORMATION

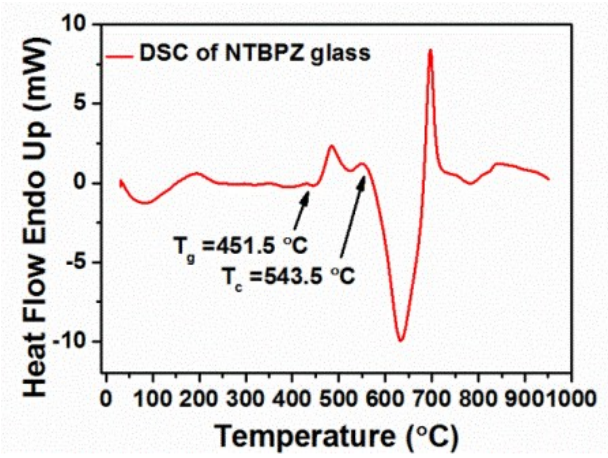

Fig. S1 DSC curve of the different ratio NTBPZ glass

Differential scanning calorimetry (DSC) (Fig. S1) shows that the glass transition temperature (T_g) and the crystallization temperature (T_c) are 451.5 °C and 543.5 °C, respectively. A part of NTBPZ glass phase can transform into $NaTi_2(PO_4)_3$ crystals, when the heat-treat temperature beyond over 451.5 °C. The nucleus can be formed with the heat-treat temperature between 515 °C and 520 °C. Subsequently, a pure crystalline phase of the $NaTi_2(PO_4)_3$ can be formed by reducing the heat-treat temperature between 500 °C to 515 °C,

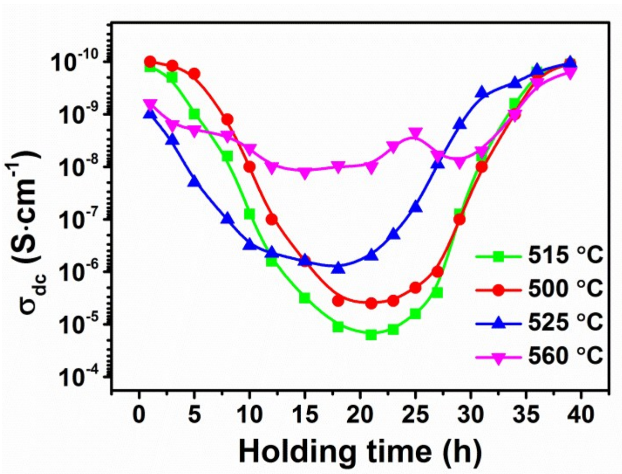

Fig. S2 The change of the sodium-ion conductivity with holding time under different heat-treat temperature.

Fig. S2 shows controlling the heat-treat temperature and the holding time is the key to improve the sodium-ion conductivity. The result shows that the heat-treat temperature and the holding time are two important factors affecting the grain size and uniformity, then affected the ionic conductivity. Consequently, the best sodium-ion conductivity of the NTBPZ glass-ceramic can be gained with holding time of 20 h under 515 °C.

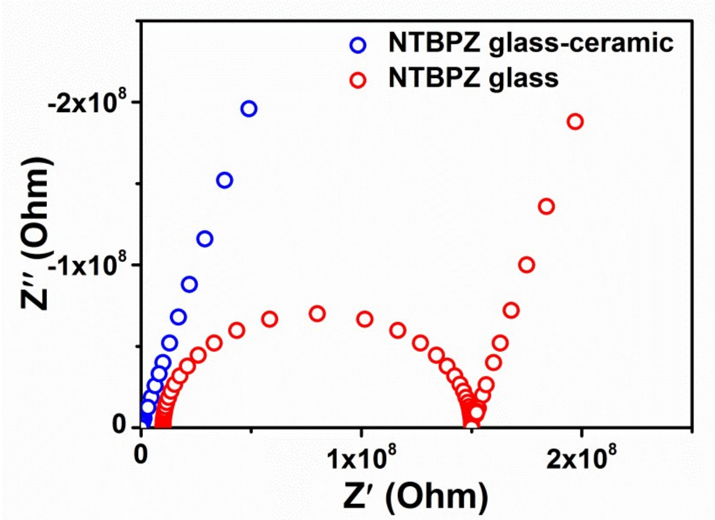

Fig. S3 Complex impedance plots for the NTBPZ glass and glass-ceramic at 25 °C after cold pressing at 32 MPa

The impedance plots of the glass pellet exhibit a big semicircle and a spike in the low-frequency region, suggesting that the NTBPZ glass behaves as large resistances, which includes the bulk-grain and grain-boundary resistances. The conductivity of the NTBPZ glass is only 2×10^{-9} S·cm^{-1}, which is determined from the cross-sectional resistance between the semicircle and the spike on the x axis (Fig. S3).

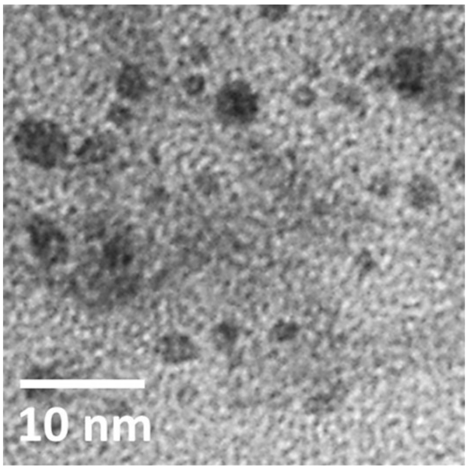

Fig. S4 TEM image of the NTBPZ glass-ceramic.

Fig. S4 shows a lot of nanocrystal distribute in NTBPZ glass-ceramic homogeneously.

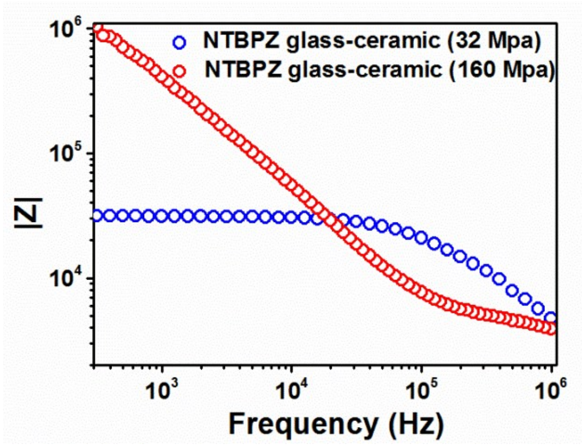

Fig. S5 Bode plots of the pellets of the NTBPZ glass-ceramic at 25 °C after cold pressing at 160 MPa and 32 MPa, respectively

Fig. S5 shows the absolute values of impedance |Z| as a function of frequency of NTBPZ glass-ceramic at 32 MPa behave completely differently from the NTBPZ glass-ceramic at 160 MPa. The NTBPZ glass-ceramic at 160 MPa has smaller impedance than NTBPZ glass-ceramic at 32 MPa in the high-frequency range from 10^3 to 10^6 Hz.