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

An optical perspective on the thermal-activated ionic migration state and ionic jumping distance in glass

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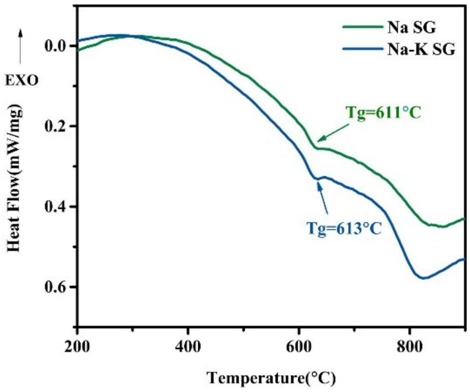

Fig. S1 DSC curves of the Na SG and the K-Na SG.

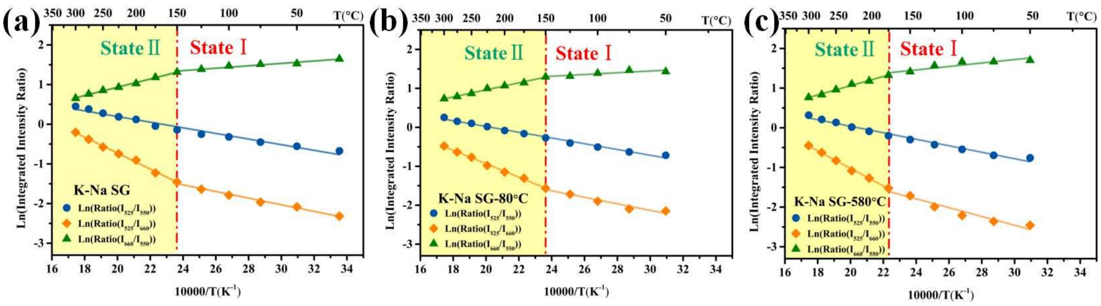

Fig. S2 The Ln~1/T plot of the (a) K-Na SG, (b) K-Na SG-80 °C and (c) K-Na SG-580 °C.

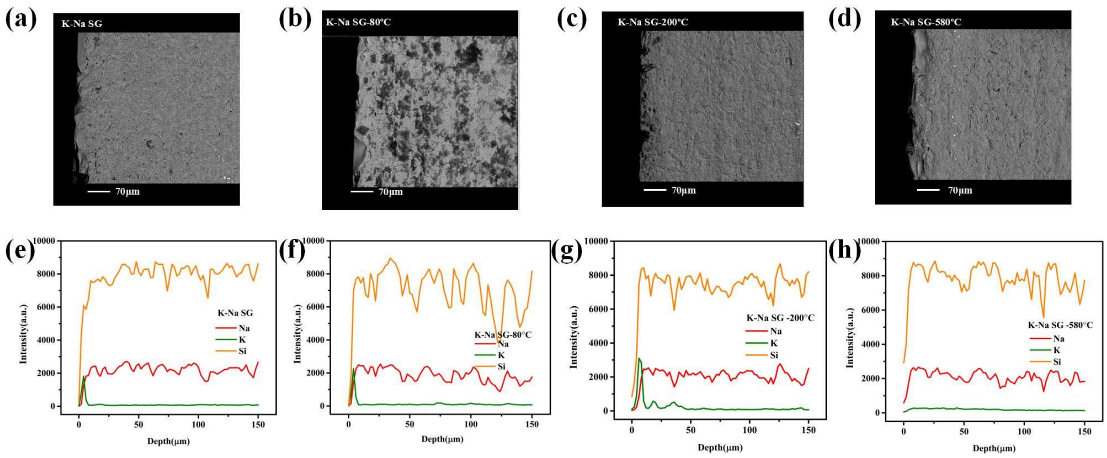

Fig. S3 EPMA images and the elemental line-scanning images of the (a, e) K-Na SG, (b, f) K-Na SG-80 °C, (c, g) K-Na SG-200 °C, and (d, h) K-Na SG-580 °C.

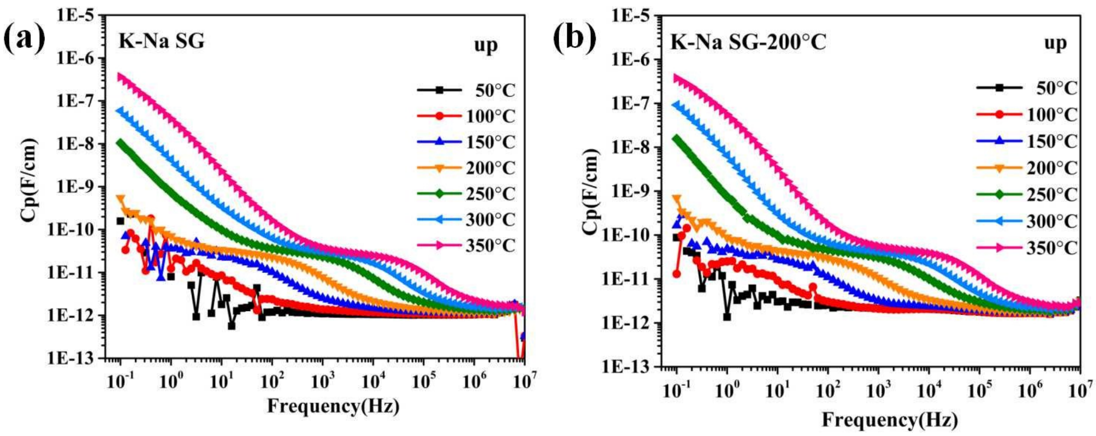

Fig. S4 Permittivity of (a) K-Na SG and (b) K-Na SG-200 °C as a function of frequency at different temperatures.

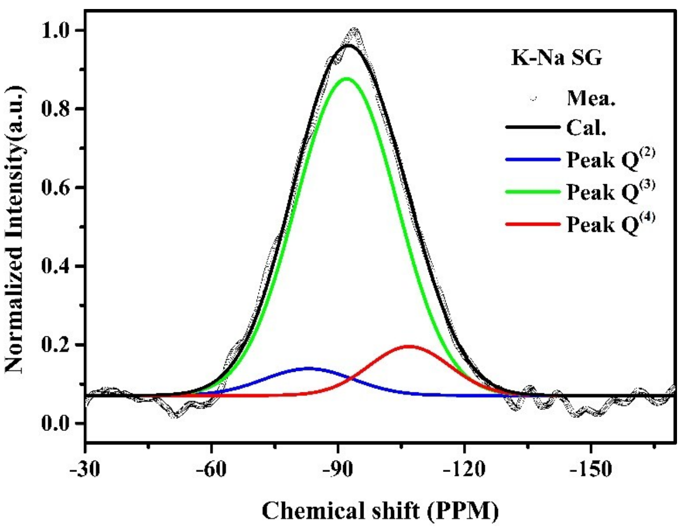

Fig. S5 ^{29}Si MAS NMR spectra of K-Na glass samples (circles), the integrated areas (black line) and the Gaussian fits for each site.

The specific calculation process for the initial distance *D* between mobile Na^+ and Er^{3+}：

$W(K_2O)$ =19.08%　　　$W(Er_2O_3)$ =2.85%　　　ρ=2.79 g/cm^3

$$N(Na^+) = 2N_A \frac{\rho \cdot W(Na_2O)}{M(Na_2O)}$$

$$= 2 * 6.02 * 10^{23}(/mol) * \frac{2.79(g/cm^3) * 0.1908}{61.97(g/mol)}$$

$$= 1.03 * 10^{22}(ion/cm^3)$$

$$N(Er^{3+}) = 2N_A \frac{\rho \cdot W(Er_2O_3)}{M(Er_2O_3)}$$

$$= 2 * 6.02 * 10^{23}(/mol) * \frac{2.79(g/cm^3) * 0.0285}{382.51(g/mol)}$$

$$= 2.50 * 10^{20}(ion/cm^3)$$

$$N(Na^+) + N(Er^{3+}) = 1.06 * 10^{22}(ion/cm^3)$$

$$\frac{1}{N(Na^{+}) + N(Er^{3+})} = 9.434 * 10^{-23}(cm^3/ion) = 94.34(Å/ion)$$

$$\frac{4}{3}\pi r^3 = 94.34(Å)$$

$$r = 2.8(Å)$$

$$D = 2r = 5.6(Å)$$

Table S1 The jump distance *d* calculated by using the conductivity at different temperatures

Glass sample	**The jump distance *d* at different temperatures (Å)**						
	250°C	300°C	350°C	400°C	450°C	500°C	**average**
Na SG	1.9	1.7	1.4	1.5	1.7	2.3	**1.8**
K-Na SG	2.0	1.7	2.0	1.9	1.8	1.8	**1.9**
K-Na SG-200 °C	2.1	1.9	2.1	2.0	2.0	2.0	**2.0**