

Supporting Information

The thermodynamic calculations of sodium chloride (NaCl) and sodium fluoride (NaF) are given as below.

Table I. Thermodynamic parameters¹

Substance	H (KJ·mol ⁻¹)	G (KJ·mol ⁻¹)	S (J·mol ⁻¹ ·K ⁻¹)
NaCl	-181.4	-201.3	229.8
NaF	-290.5	-309.8	217.6
Na	107.3	76.8	153.7
Cl ₂	0	0	223.1
F ₂	0	0	202.8

The decomposition reactions of NaCl and NaF gases are given as



According to the thermodynamic equation: $\Delta G = \Delta H - T\Delta S$, the temperature T_{NaCl} required for decomposing NaCl can be calculated as follows:

$$\Delta H = 2 \cdot 107.3 - 2 \cdot (-181.4) = 577.4 \text{ KJ} \cdot \text{mol}^{-1}$$

$$\Delta S = 223.1 + 2 \cdot 153.7 - 2 \cdot 229.8 = 70.9 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$$T_{\text{NaCl}} = \Delta H / \Delta S = 577.4 \cdot 1000 / 70.9 \approx 8149.5 \text{ K}$$

Similarly, the temperature T_{NaF} required for decomposing NaF can be calculated as

$$\Delta H = 2 \cdot 107.3 - 2 \cdot (-290.5) = 795.6 \text{ KJ} \cdot \text{mol}^{-1}$$

$$\Delta S = 202.8 + 2 \cdot 153.7 - 2 \cdot 217.6 = 75.0 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$$T_{\text{NaF}} = \Delta H / \Delta S = 795.6 \cdot 1000 / 75.2 \approx 10579.8 \text{ K}$$

In the present study, the reaction happened at the temperature of 1250°C (1523K), which was far lower than the decomposition temperatures T_{NaCl} and T_{NaF} . Thus, the NaCl and NaF melts at 1250°C would not be decomposed into Na and Cl₂ and into Na and F₂, respectively.

Reference

1. I. Barin, Thermalchemical Data of Pure Substances, Wiley-VCH, 1997.