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Structural and electrochemical characterization of sodium solid electrolyte

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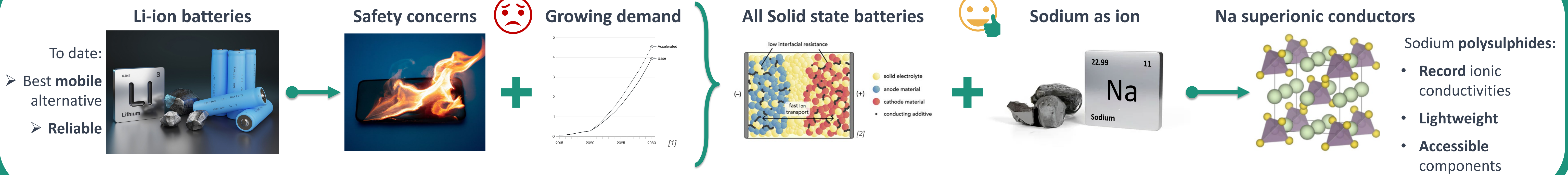
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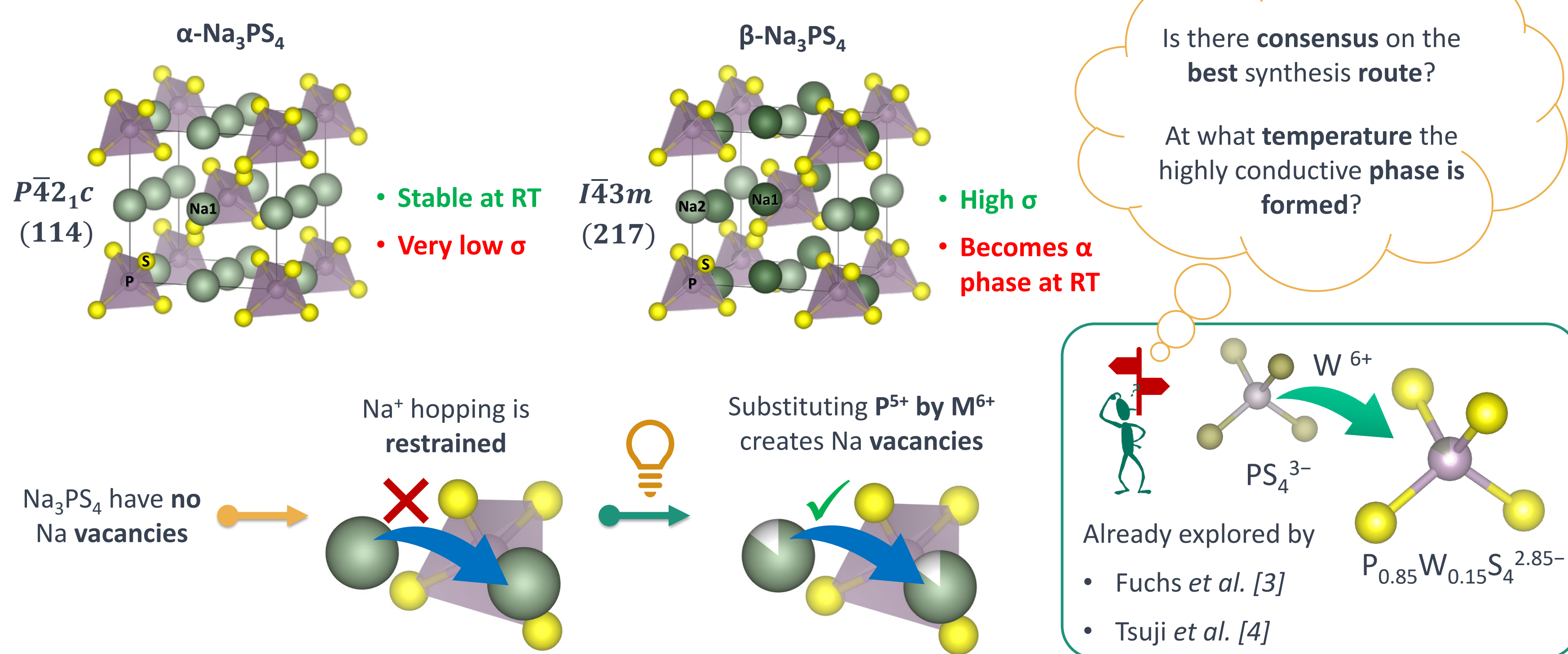
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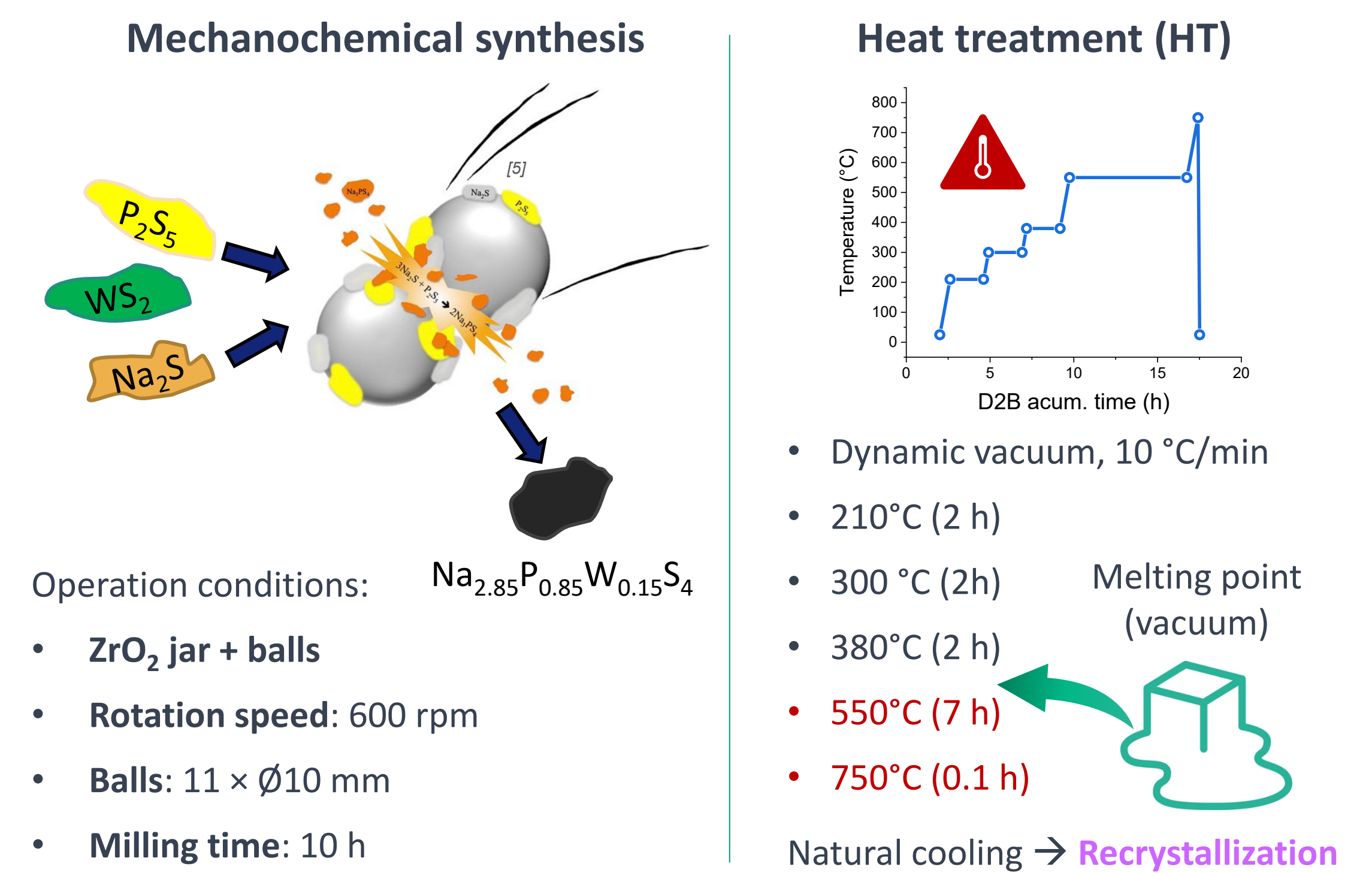
Introduction



Strategy

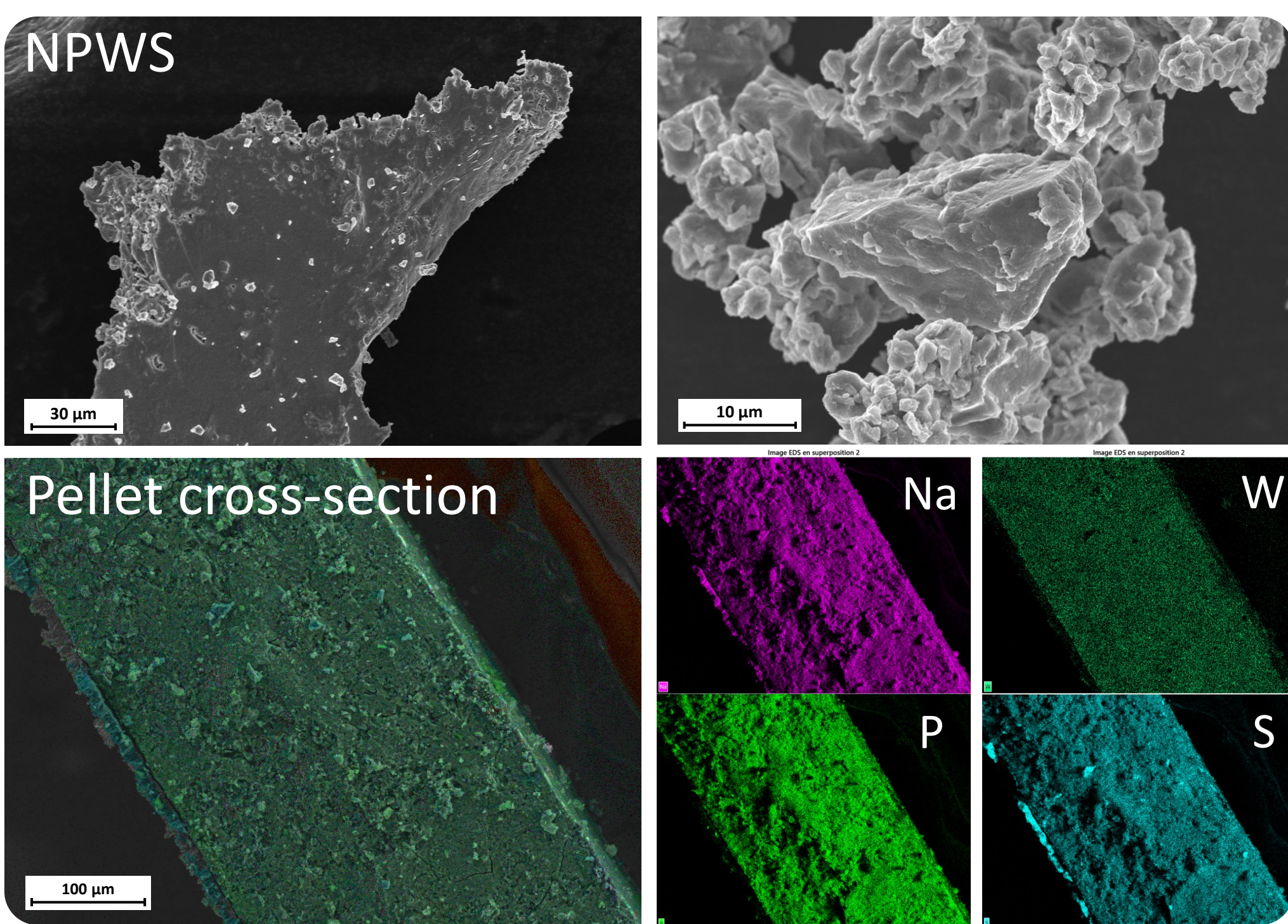


Methodology

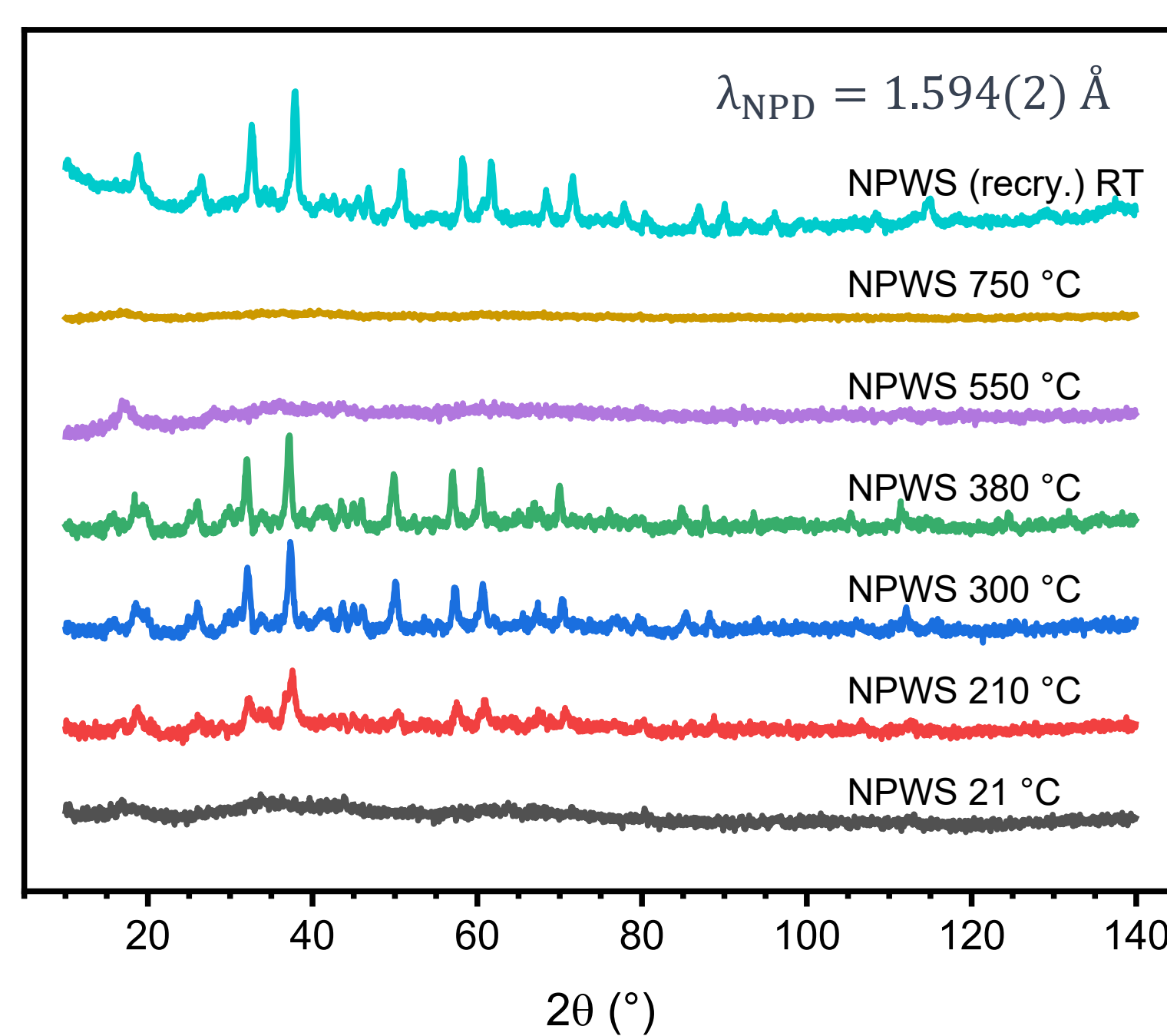


Results and discussion

$\text{Na}_{2.85}\text{P}_{0.85}\text{W}_{0.15}\text{S}_4$ (NPWS) – Scanning electron microscopy-EDS

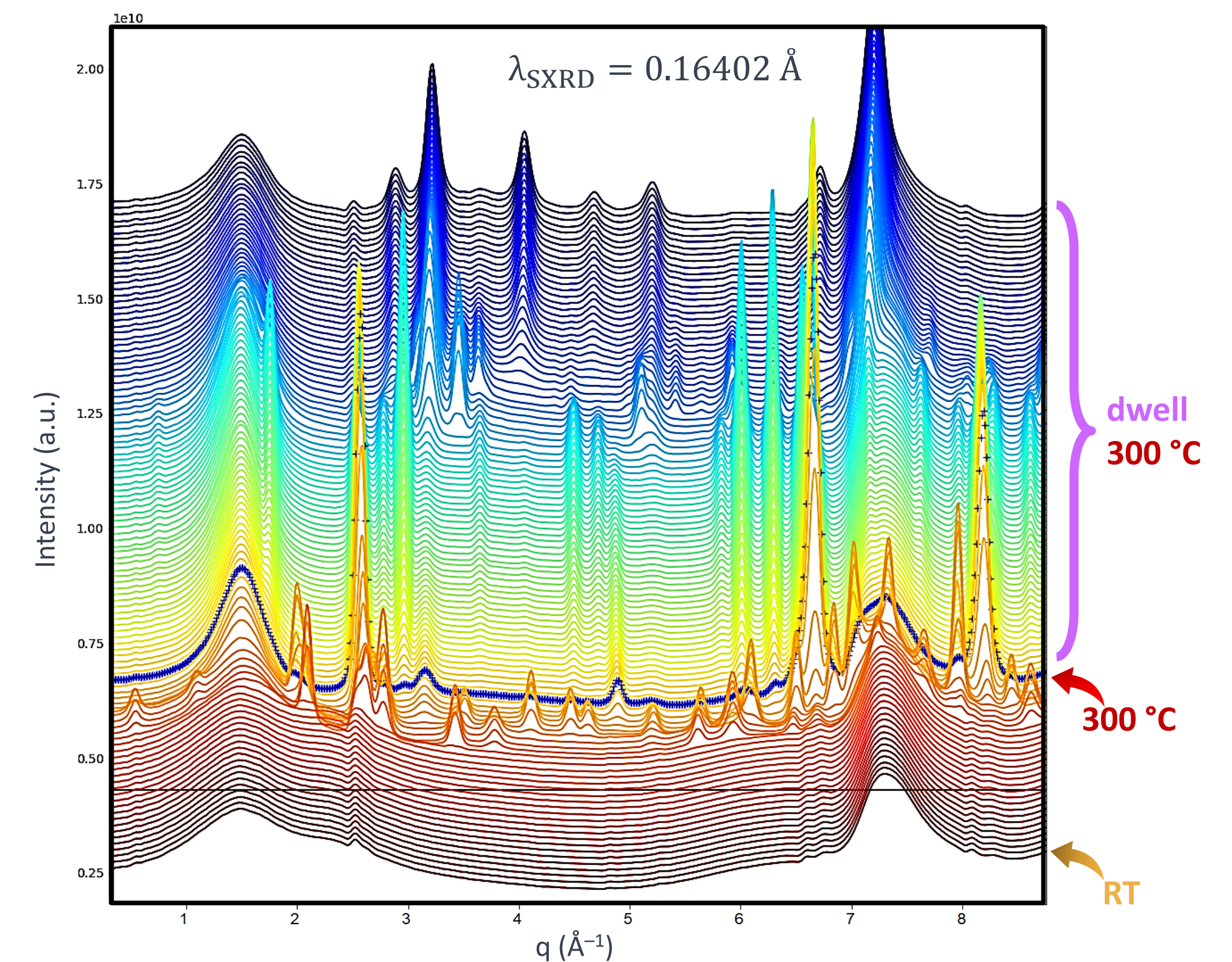


Neutron powder diffraction (NPD)

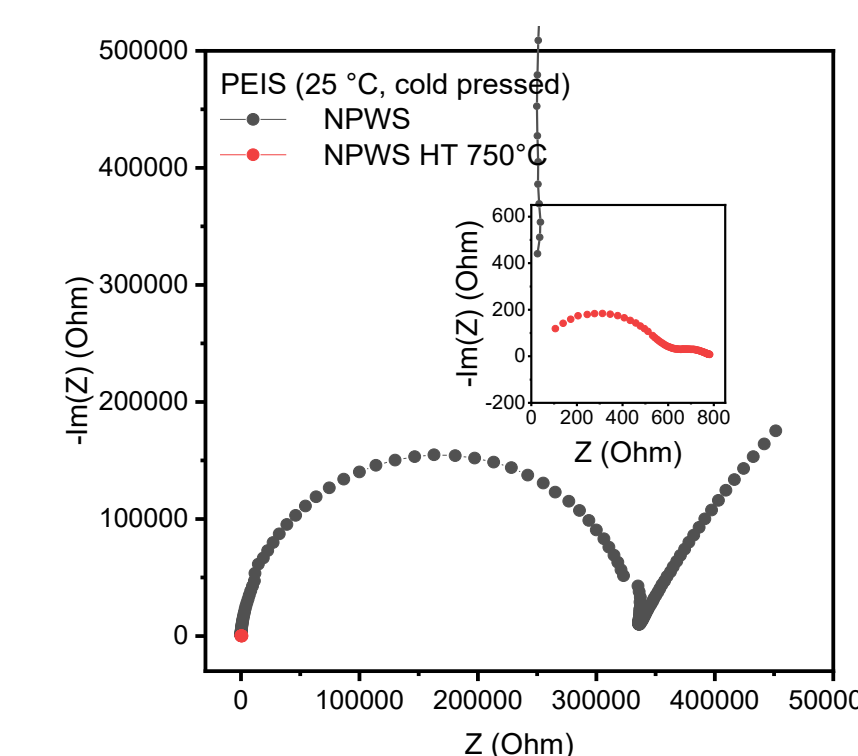


- NPWS introduced in oven under vacuum
- NPWS melts before 550 °C (vacuum)

Synchrotron X-ray diffraction (SXRD)



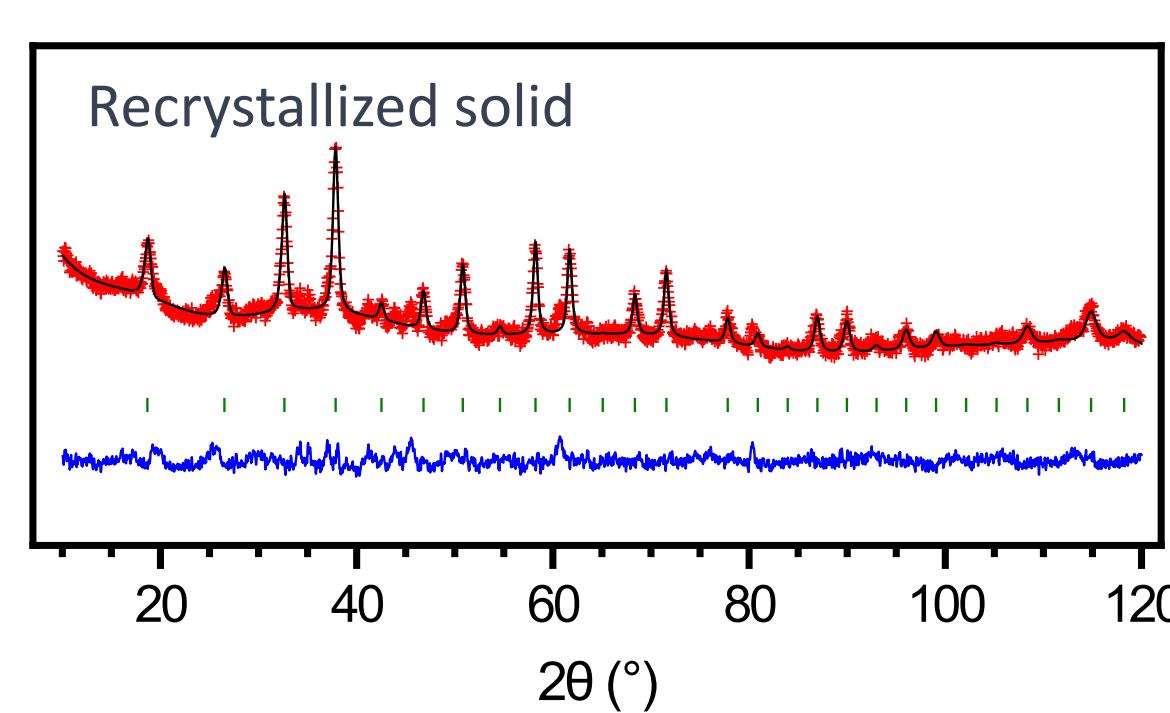
Impedance Spectroscopy (PEIS)



Sample	Compacity (%)	Ionic conductivity (S/cm)
NPWS	80.9	$3.1 \cdot 10^{-7}$
NPWS HT 750 °C	84.1	$1.3 \cdot 10^{-4}$

× 420 ✓

NPD Rietveld refinement



β - $\text{Na}_{2.85}\text{P}_{0.85}\text{W}_{0.15}\text{S}_4$

» Cubic $I\bar{4}3m$ (217) space group

» Na1 found in high multiplicity site

» $f_{\text{occ}} < 1$

✓ Percolation favoured

Na⁺ ions pathway (by BVEL)

Na1

P/W

Conclusions and overview

Ball milled NPWS ➤ amorphous

Recrystallization ➤ β phase (stable at RT)

✓ Na hop favored ➔ $\sigma_{\text{ion}} \times 420$ ✓

• Transient phase @ ~275 °C

• Multiple phases during hold @ 300 °C

- Can they be isolated?

- Electrochemical performance?

• Phase identification @ ≠ time & Temp

• Long rest @ 300 °C & 380 °C (12 h)

• Electrical conductivity negligible? Electrochem. stability window, plating stripping, full cell...