

# Impact of Thermal Exposure on Crystallization Rate and Mechanical Properties of Thermoplastic Composite

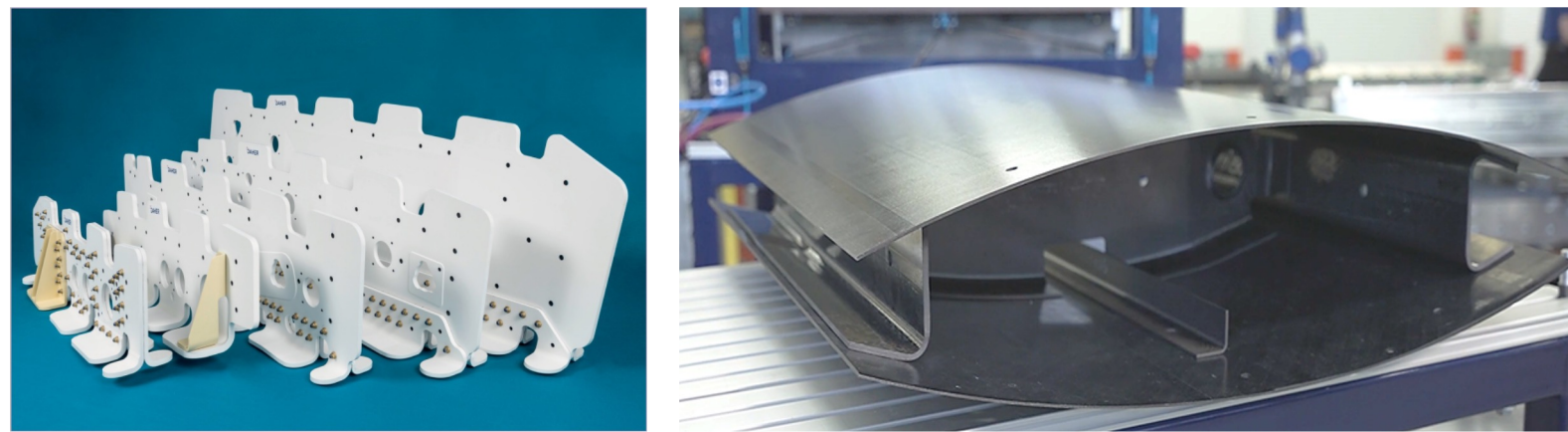


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## Background

Thermoplastic composites are advantageous due to their lightweight properties, high strength, sustainability, and manufacturability.

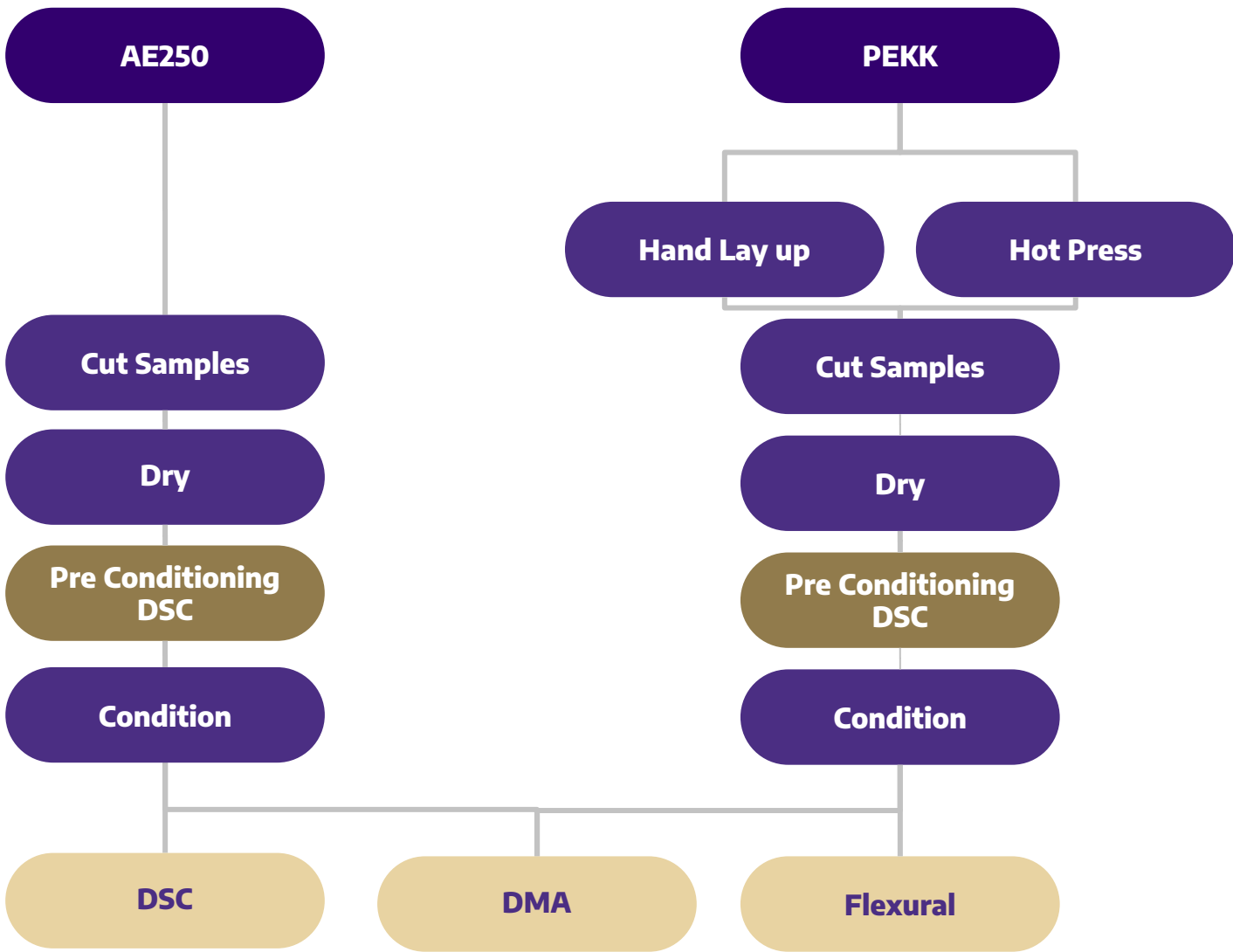
Unlike thermosets, thermoplastic composites can be reheated and molded after consolidation. Reheating risks changing the material properties of the matrix so identifying processing conditions that do not impact crystallinity or mechanical properties is crucial in the use of thermoplastic composites.



Daher thermoplastic ribs, and torsion box

## Materials Under Study

- **PEKK** (Polyetherketoneketone): High mechanical performance, excellent heat resistance, and ideal for aerospace structural applications.
- **AE250** (PAEK, Polyaryletherketone): Balanced mechanical strength, good thermal stability, and cost-effective processing.



## PEKK Panel Manufacturing

### Layup

- 6 quasi isometric panels (16-ply, 305mm x 305mm)
- **Thermocouples** embedded

### Consolidation

- Hot Press
  - 30 min at 377 °C, under 5 Bar Pressure



## Thermal Conditioning

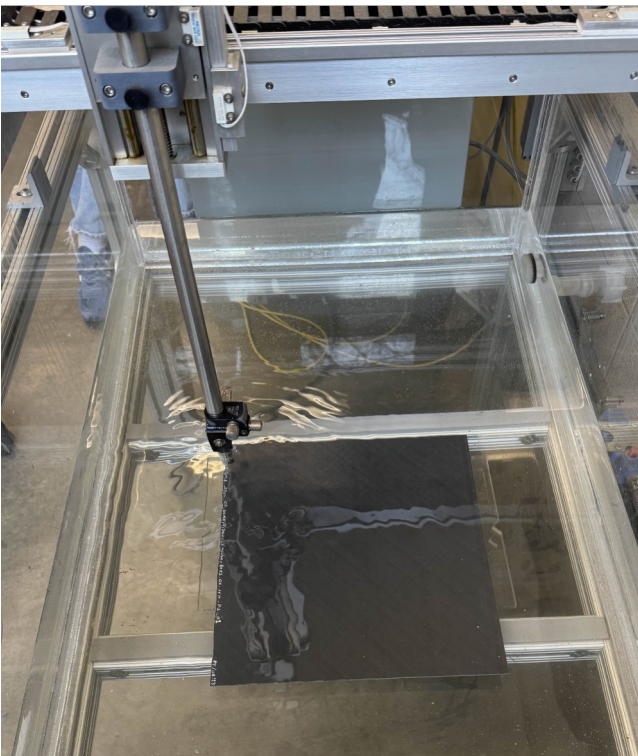
Panels		Conditions	
PEKK Panel	AE250 DAHER Panel	Temp (°C)	Time (min)
P1	D1	245	10
P2	D2	245	30
P3	D3	245	90
P4	D4	220	10
P5	D5	220	90
P6	D6	control	control
*P7	*D7	245	180

*\*Note: P7 & D7 were added as the results of the AE250 characterization tests did not indicate a substantial change in crystallization between D1-D6*

## Ultrasonic Testing

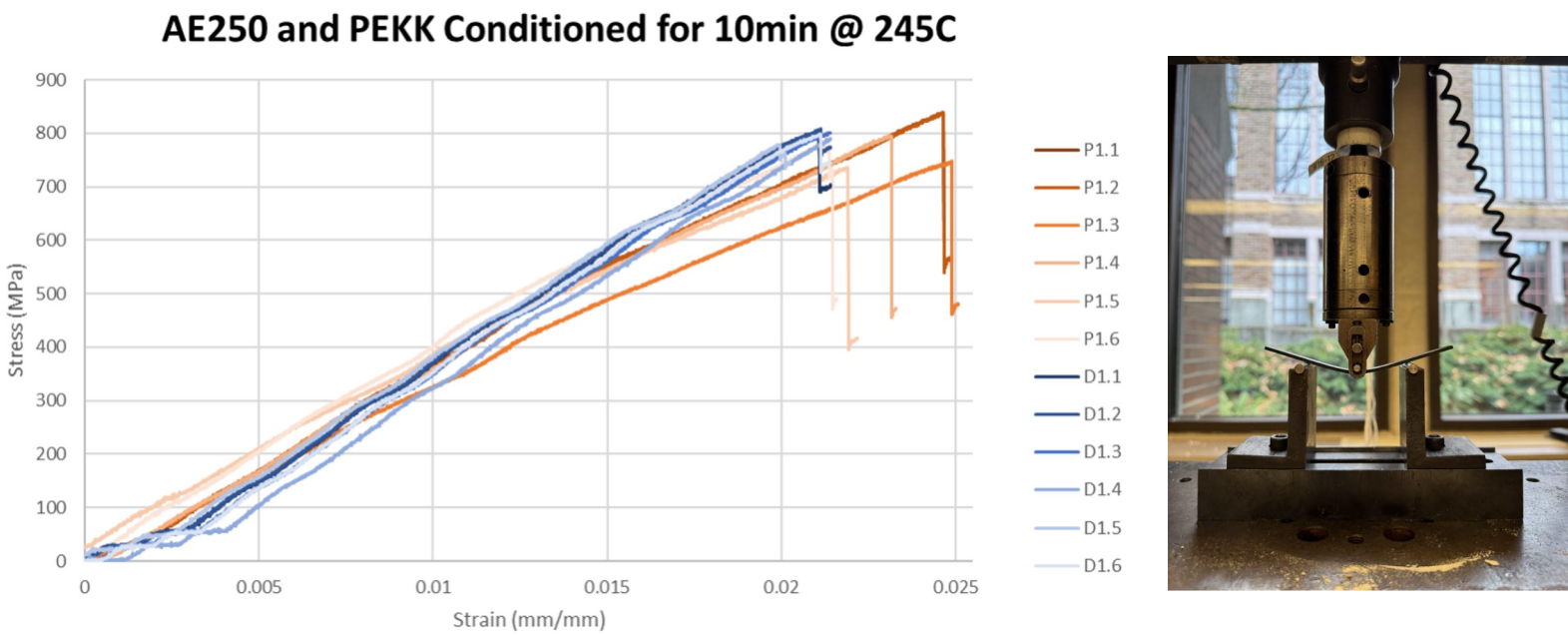
Provides a detailed map of a **material's internal structure**

- Detects defects such as cracks, voids, or delamination
- Used when cutting samples



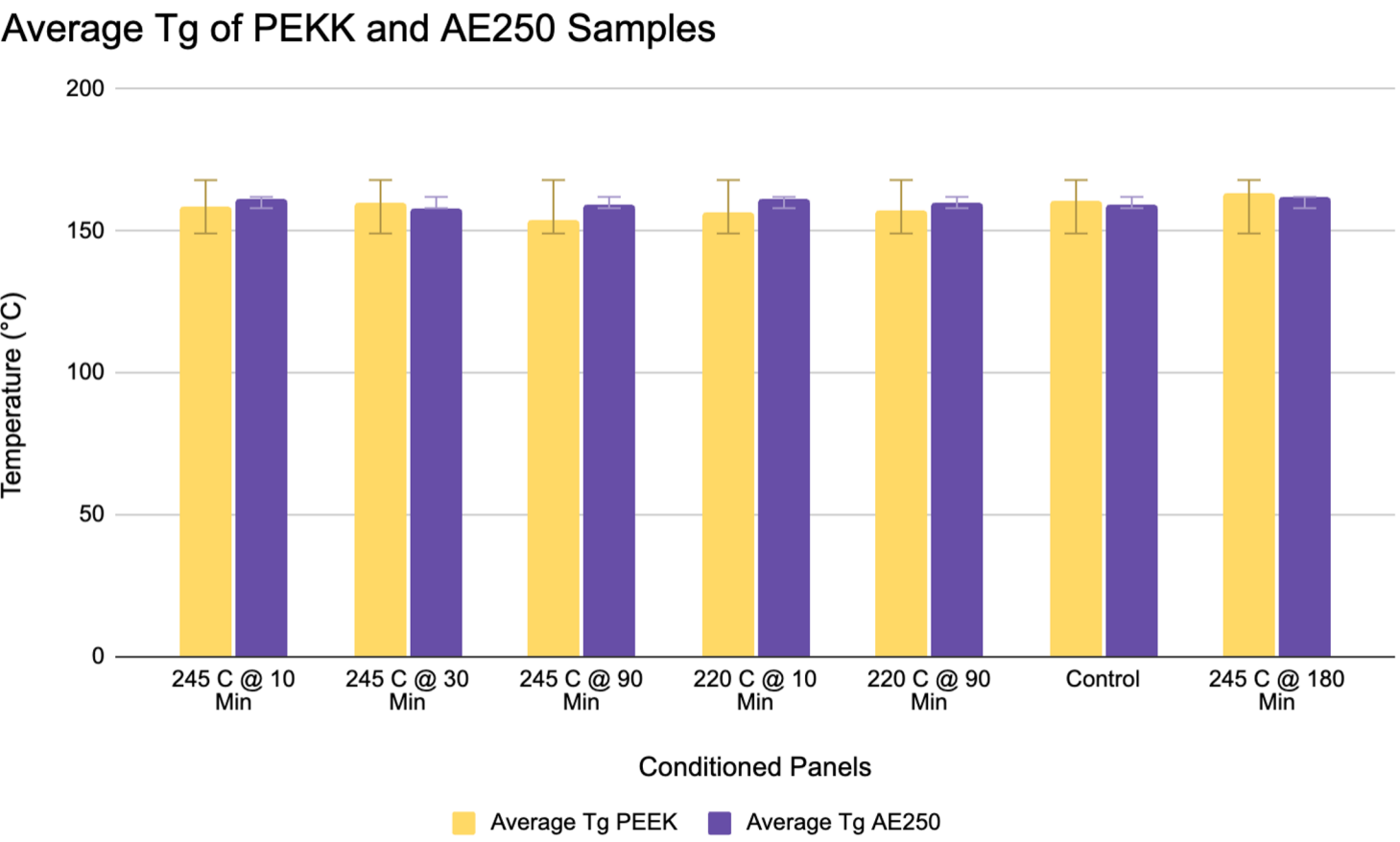
## Mechanical Characterization

### Three-Point Flexural Test



## Thermal Characterization

### Dynamic Mechanical Analysis (DMA)



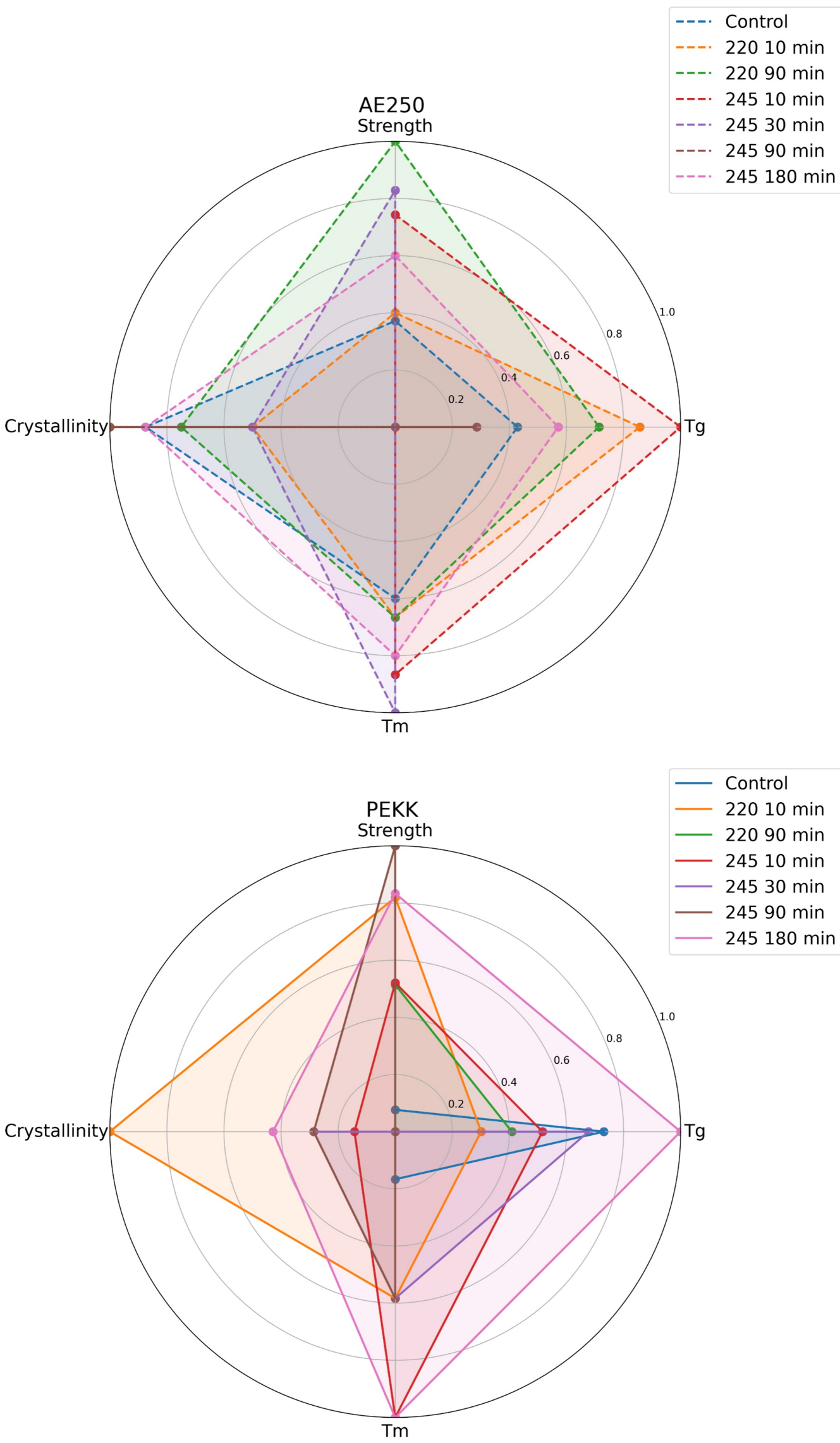
### Differential Scanning Calorimetry (DSC)

Sample	Temp (°C)	Time (min)	Average % Crystallinity
D1	245	10	24
D2	245	30	22
D3	245	90	28
D4	220	10	26
D5	220	90	25
D7	245	180	28
D6	control	control	26
P1	245	10	32
P2	245	30	35
P3	245	90	33
P4	220	10	38
P5	220	90	31
P7	245	180	34
P6	control	control	31

## Results

Post processing heating of PEKK & AE250 can occur between 220°C and 245 °C with a maximum exposure time of 180 minutes.

- No significant impact to crystallinity or material performance



## Acknowledgements