

# Mechanical and physical properties of AlMgSc-alloy developed for cryogenic temperature applications

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## Motivation:

Aluminum alloys: lightweight, good formability, and good corrosion resistance

Application: aerospace, construction and automotive

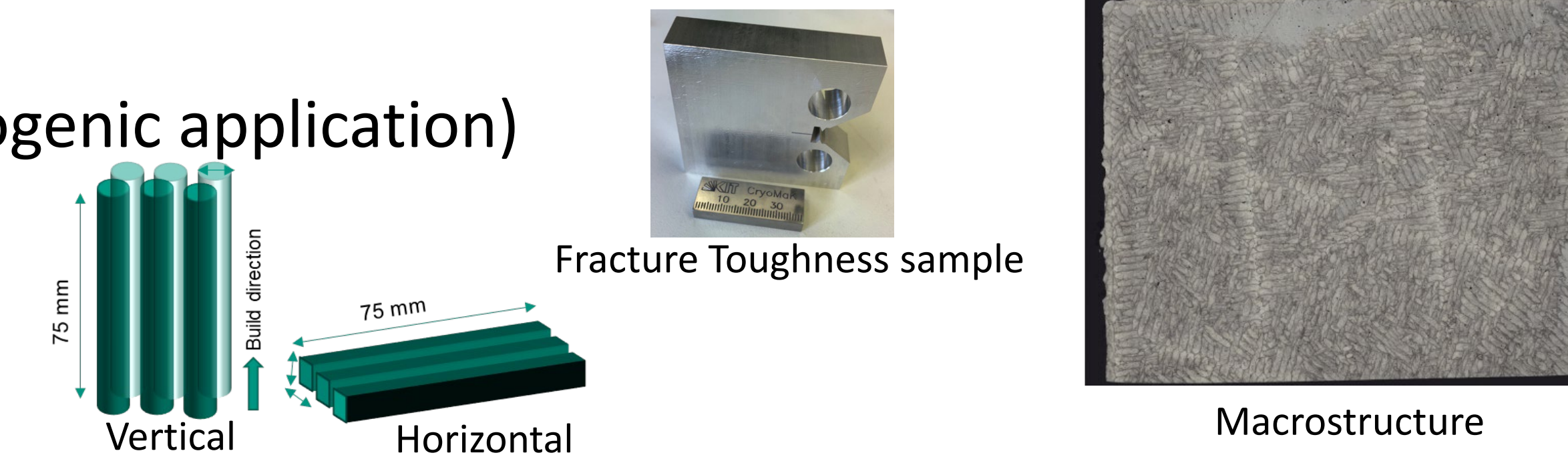
**AlMgSc-alloy (Scalmalloy):** the highest yield strength (YS), ultimate tensile strength (UTS), and elongation among the aluminum alloys manufactured by SLM

## Materials:

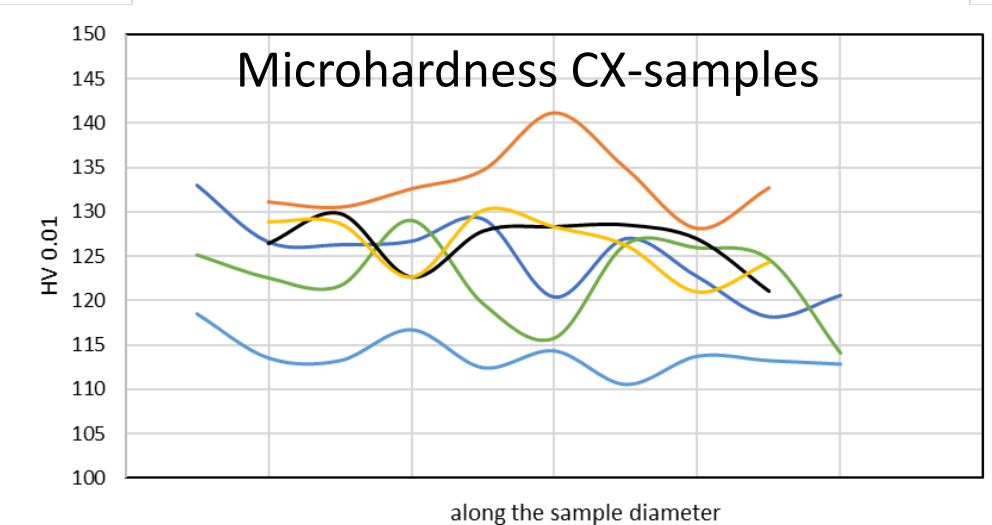
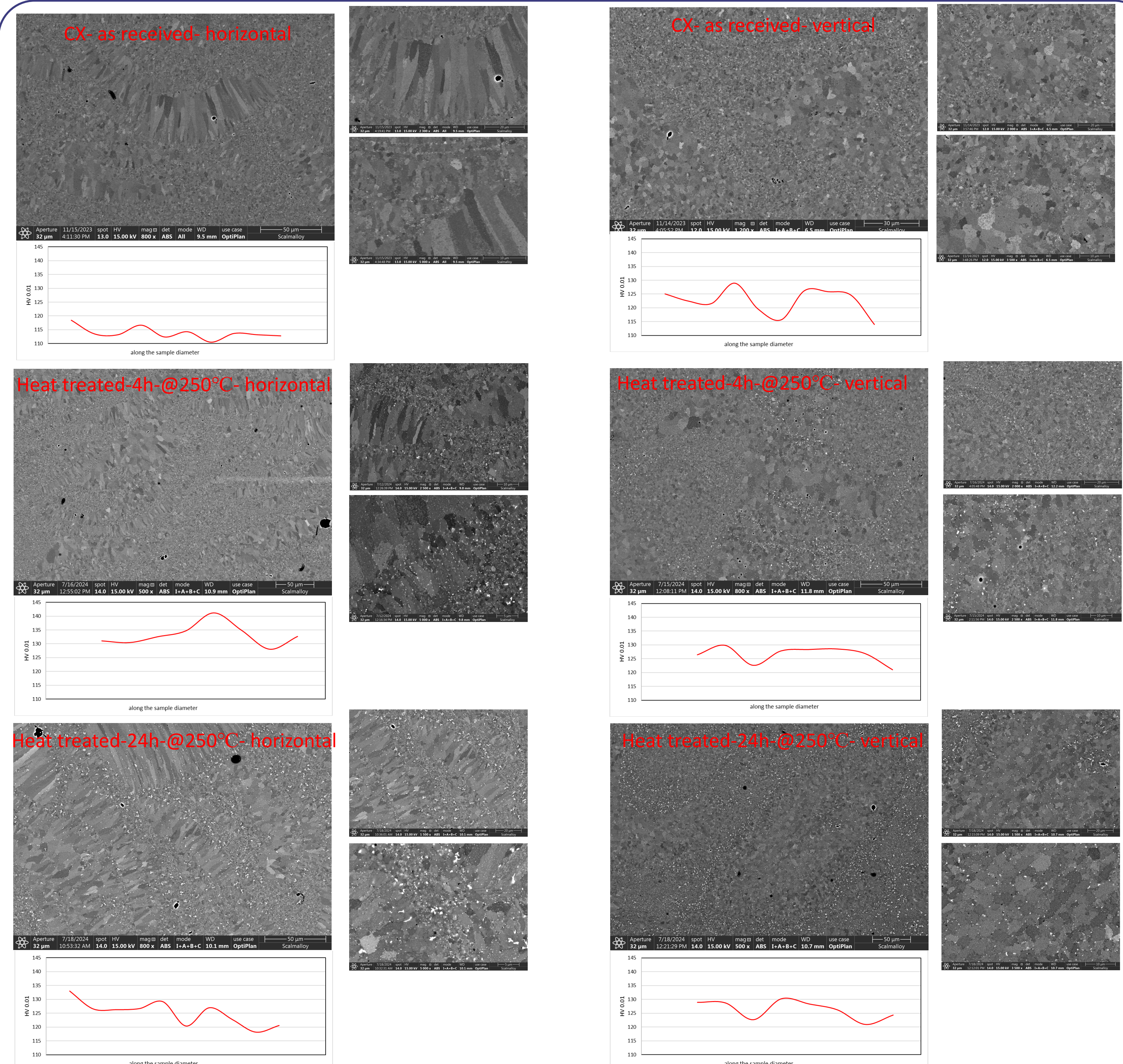
Scalmalloy (standard), Scalmalloy® CX by APWORKS (for cryogenic application)

Method:

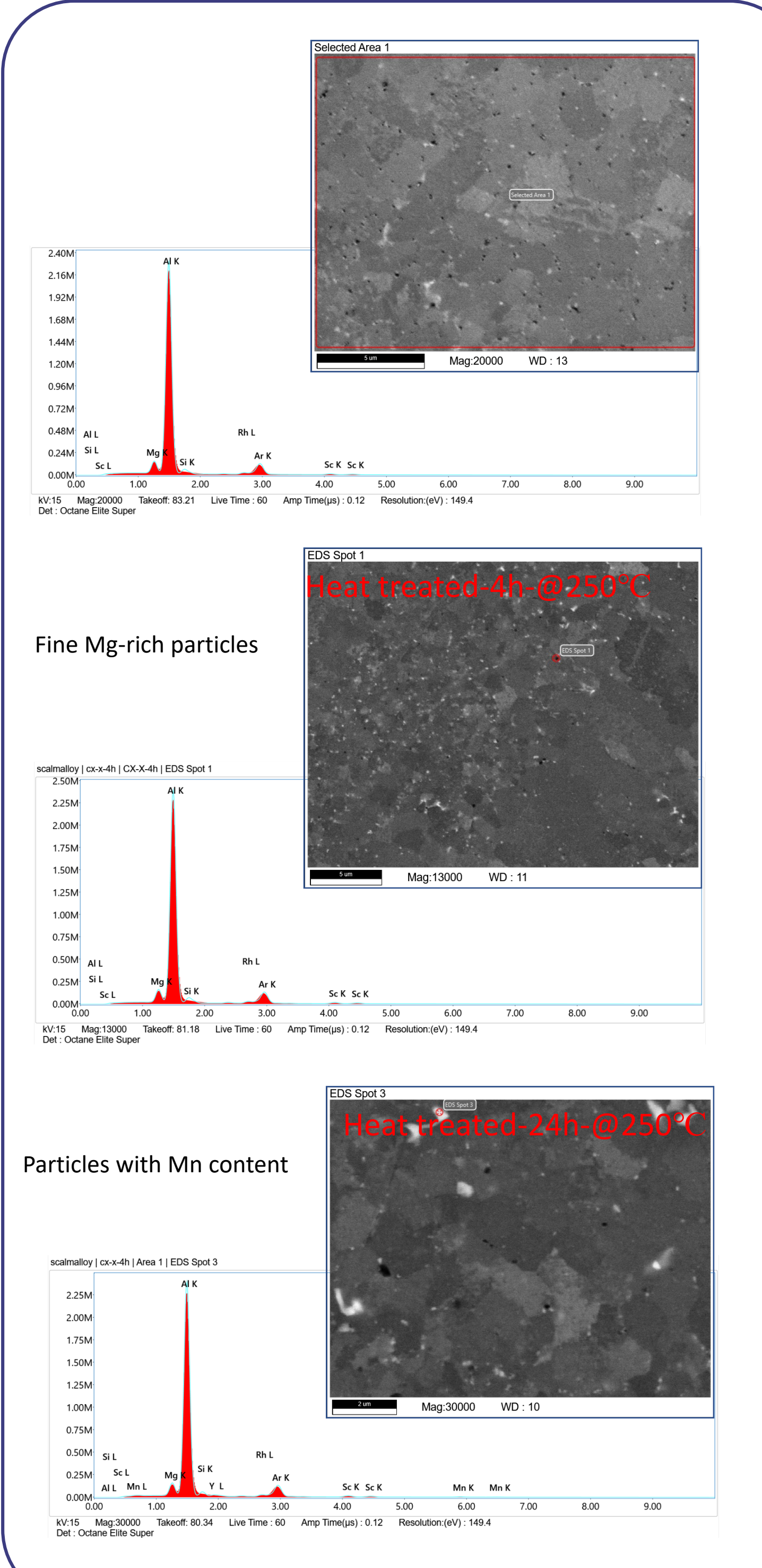
Tensile test and Fracture toughness and crack propagation  
 Both vertical and horizontal directions



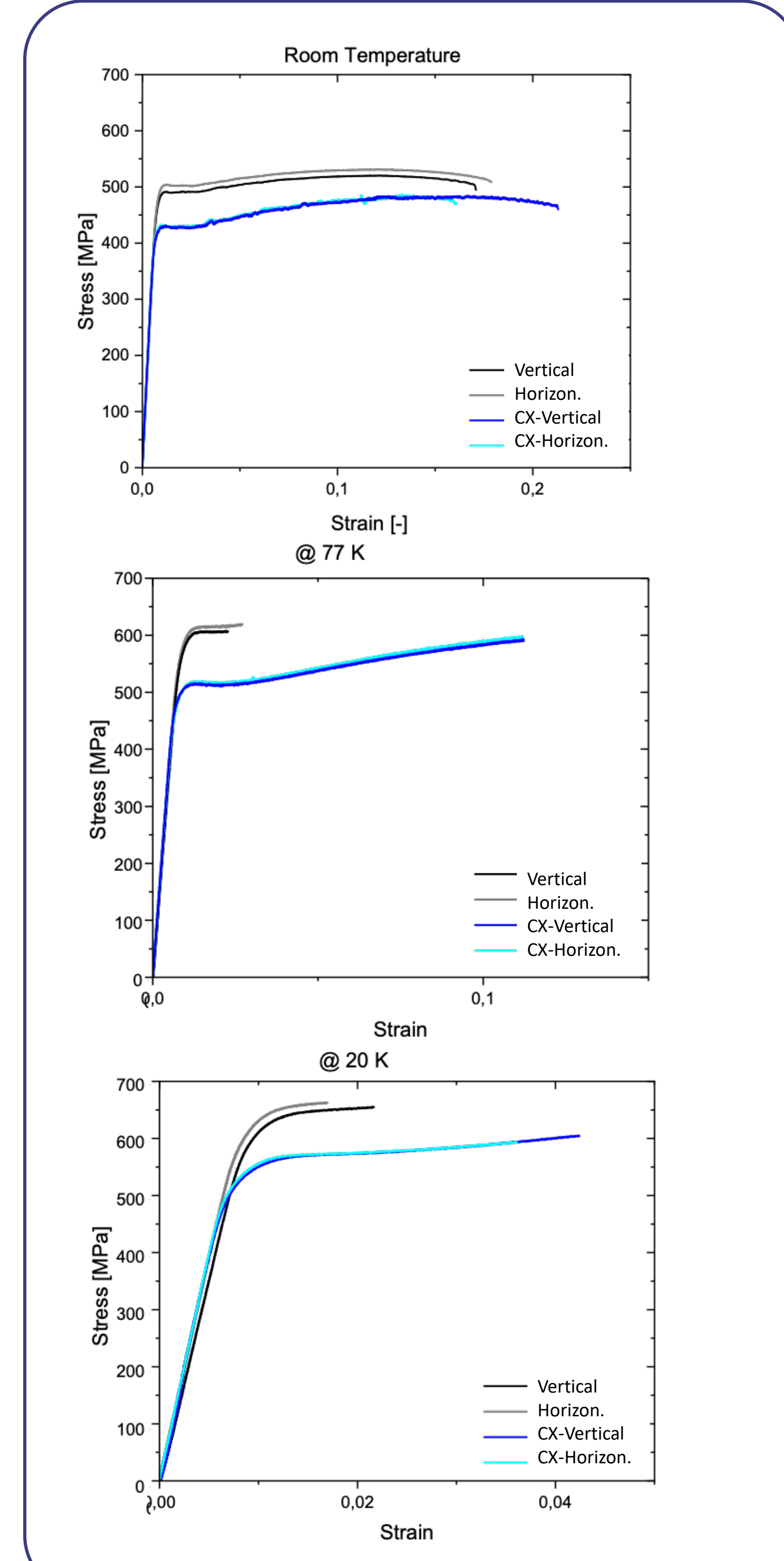
## Microstructure observation and Microhardness



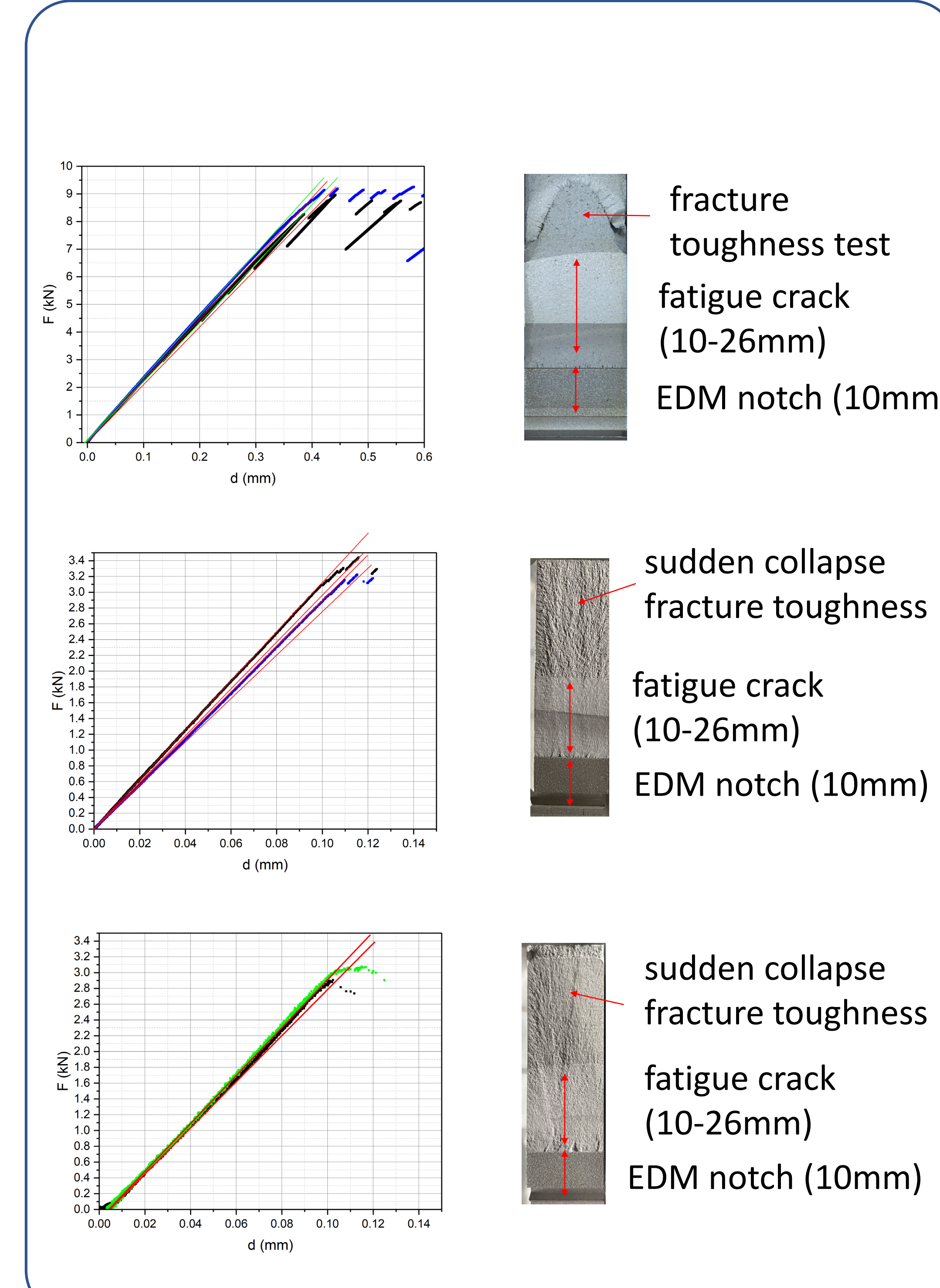
## EDS results



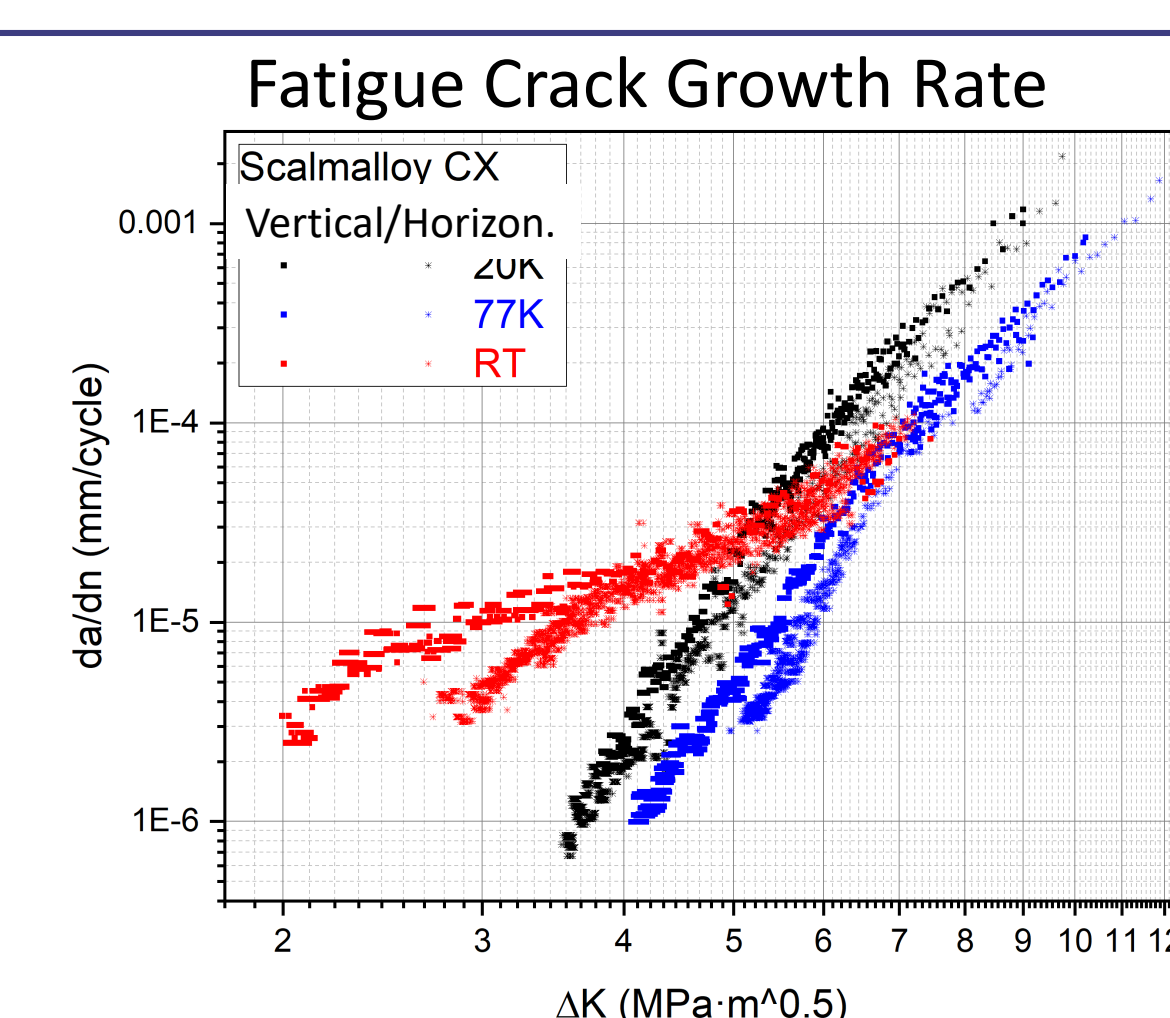
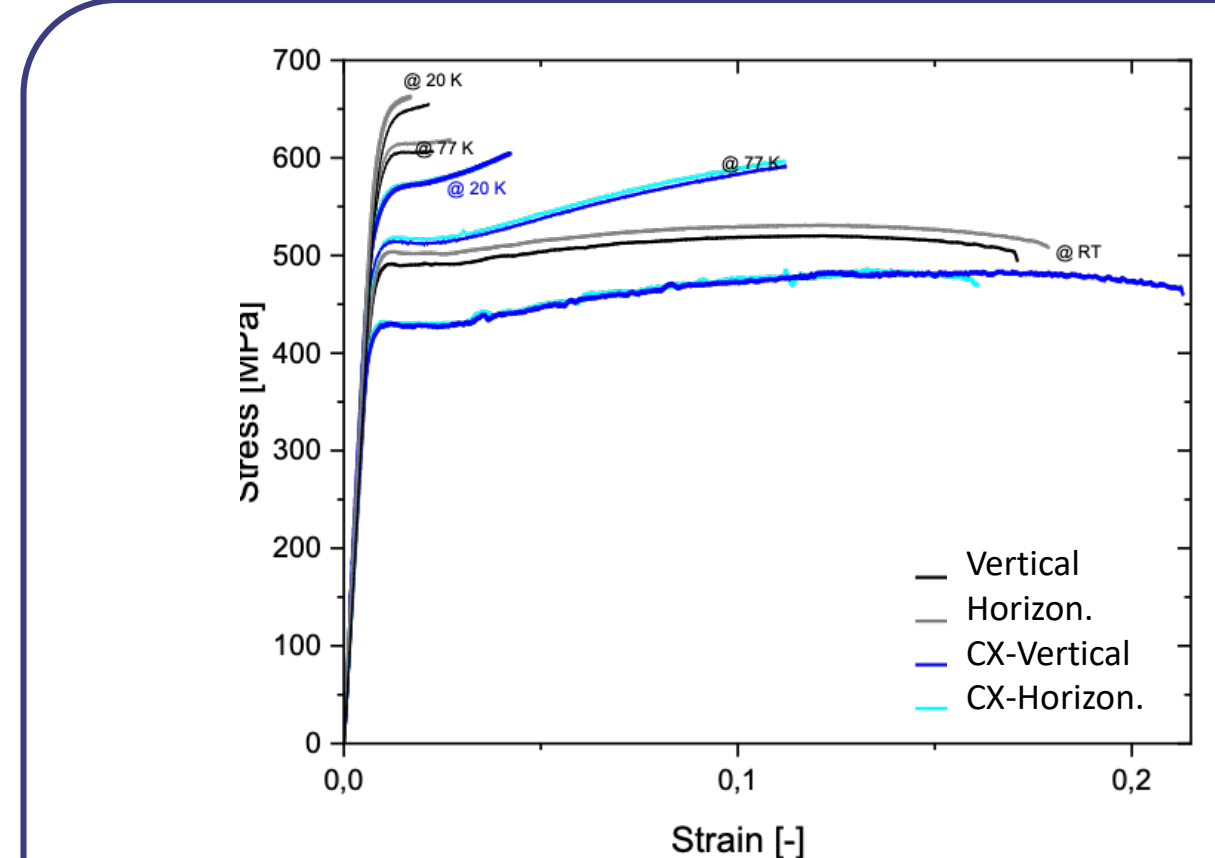
## Tensile Test



## Fracture Toughness K<sub>IC</sub>



## Results



Sample	T (K)	K <sub>IC</sub> (MPa m <sup>0.5</sup> )	Sample	T (K)	K <sub>IC</sub> (MPa m <sup>0.5</sup> )
Vertical Standard	RT	31.7	Vertical Scalm-CX	RT	43.0
Horizontal Standard	RT	28.6	Horizontal Scalm-CX	RT	43.0
Vertical Standard	77K	10.8	Vertical Scalm-CX	77K	20.2
Horizontal Standard	77K	10.0	Horizontal Scalm-CX	77K	24.0
Vertical Standard	20K	9.5	Vertical Scalm-CX	20K	13.4
Horizontal Standard	20K	9.0	Horizontal Scalm-CX	20K	14.9

## References

L. Cabrera-Correa, et al. "Materials Characterization" 196 (2023): 112549.  
 C. N. Kuo, et al. "Metals" 11.4 (2021): 555.  
 A. B. Spierings, et al. "Materials Science and Engineering: A" 701 (2017): 264-273.  
 Apworks: <https://www.apworks.de/scalmalloy-cooling-pipes>

- Scalmalloy-(Standard) : Higher strength, Less elongation
- Scalmalloy-CX (cryo): Lower strength, Higher elongation

The fatigue crack growth rate reduced by temperature

Scalmalloy-CX (cryo) has higher K<sub>IC</sub> in comparison to Standard sample with a descending manner by reducing temperature in both samples.