First International Conference on Heterostructured Materials (HSM I)
12 - 15 July 2022, Hong Kong, China

FORMATION OF A HETEROGENEOUS MICROSTRUCTURE IN A MEDIUM ENTROPY ALLOY OF THE FE-CO-NI-CR-C SYSTEM

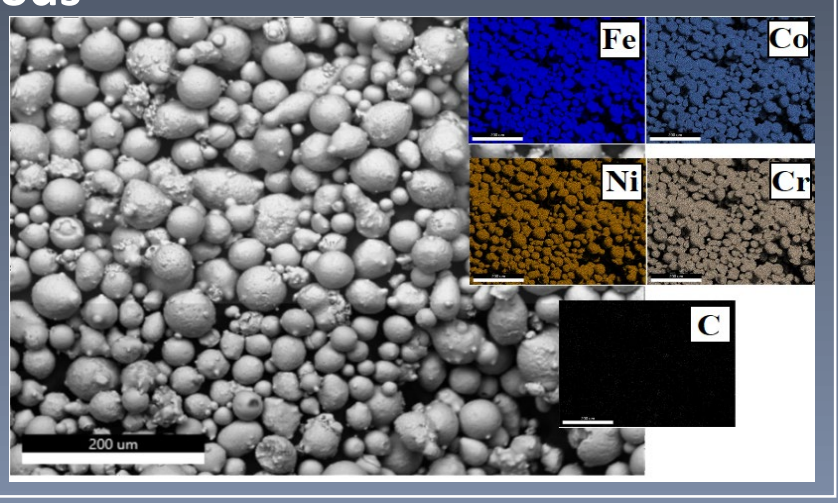
Povolyaeva E. A.*, Astakhov I. I., Shaysultanov D. G., Stepanov N. D., Zherebtsov S. V.

Abstract

It is well known that high entropy alloys (HEAs and MEAs) have an almost infinite compositional area to create materials that allow opening more diverse microstructures with improved mechanical properties. This work presents studies of the microstructure and mechanical properties of one of the medium entropy alloys of the Fe-Co-Ni-Cr-C system, obtained by a modern method of additive technologies.

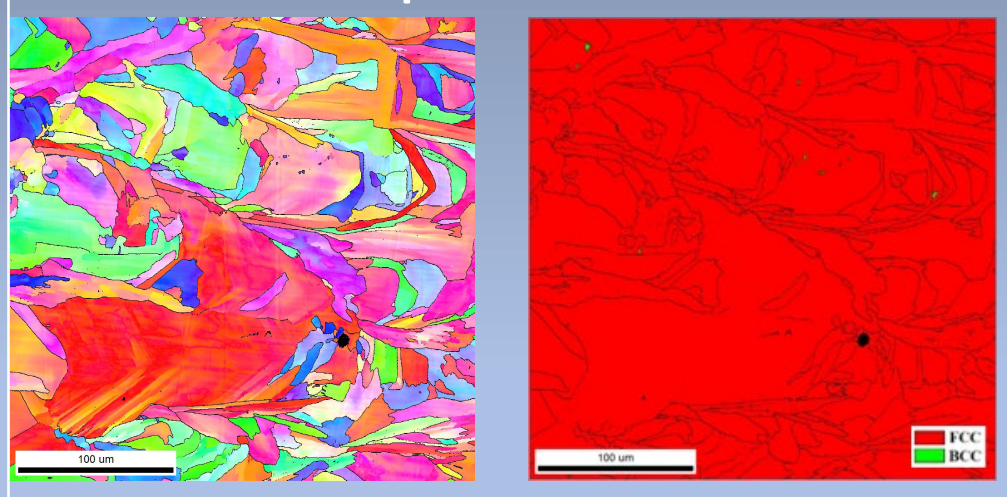
Materials and methods

To obtain alloys by selective laser sintering (SLM), the powder was certified using scanning electron microscopy scanning electron microscopy (SEM).
The $Fe_{65}(CoNi)_{25}Cr_{9.5}C_{0.5}$ alloy was obtained by the SLM.
The microstructure of the alloy was studied using TEM, SEM and EBSD analysis. Tensile tests were carried out to evaluate mechanical properties.

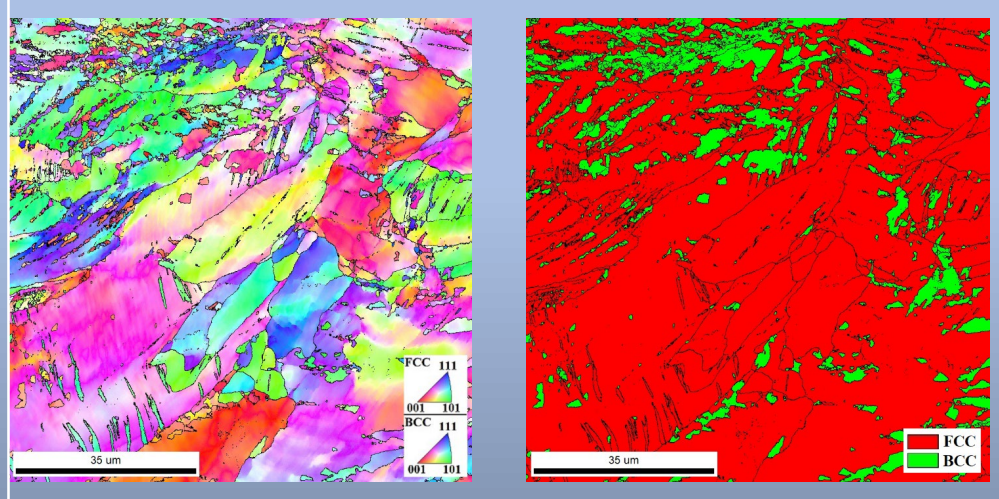


Alloy microstructure

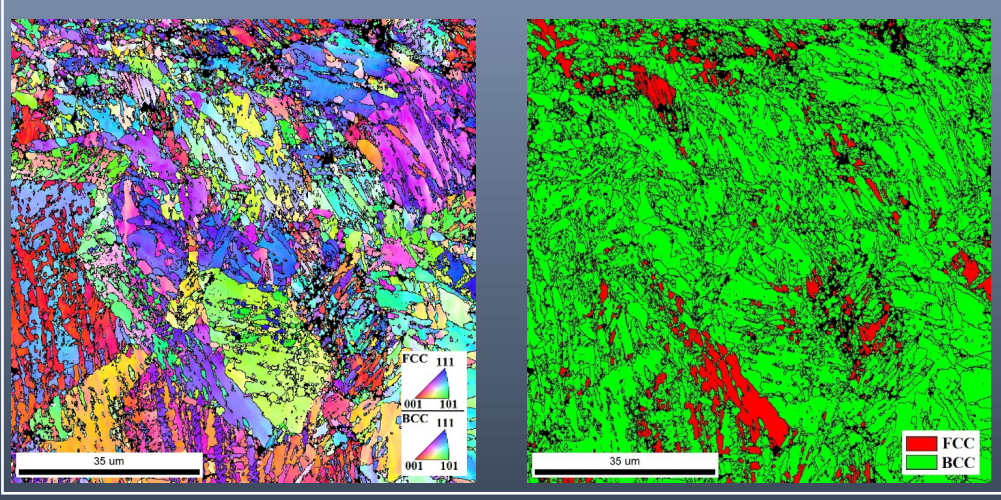
As-printed state



Condition after tensile test (25 ℃)

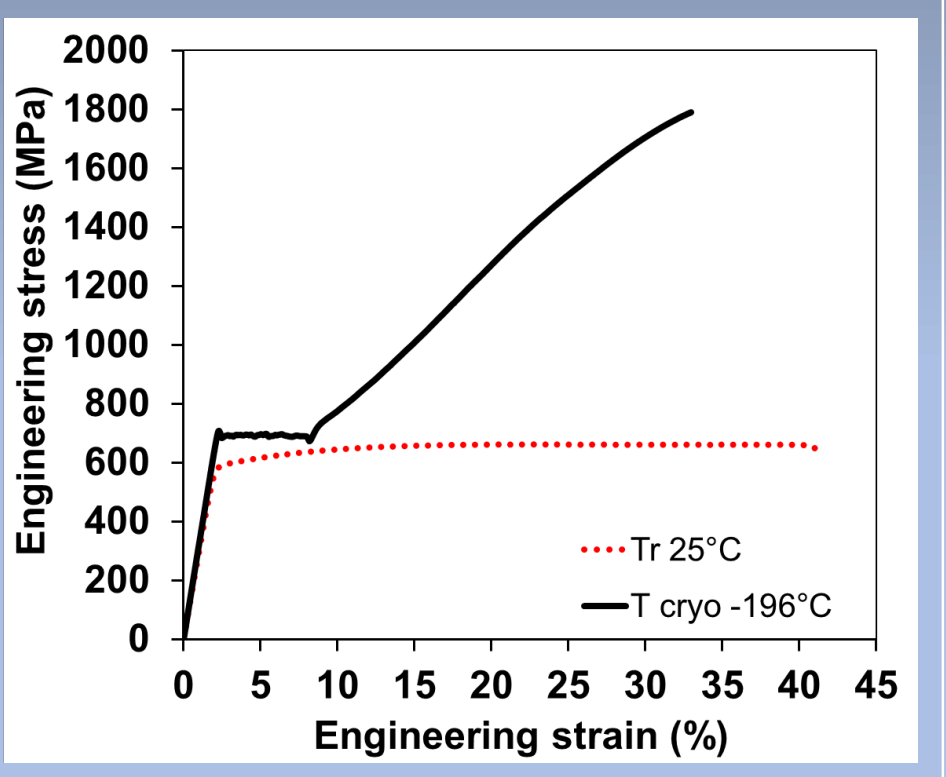


Condition after tensile test (-196 ℃)



Mechanical properties of the alloy

Tensile test



Test temperatures	YS, MPa	UTS, MPa	TE, %
25 ℃	700	1801	27
-196 ℃	626	639	36

Impact test

Test temperatures	Fracture toughness, kJ/m²	Charpy V-notch impact energy, J
25 ℃	658	10,2
-196 ℃	426	6,5

Conclusions

The alloy in the initial as-printed state has a two-phase structure (fcc - 99% and a small fraction of bcc - 1%). During tensile tests at cryogenic temperatures, the alloy exhibits the so-called TRIP effect (transformation-induced plasticity). The tensile strength of the alloy reaches a high value (σB = 1801 MPa), while its relative elongation to failure remains at a decent level (δ = 27%). Examination of the alloy after tensile tests showed the formation of a heterogeneous microstructure due to the fcc-to-bcc martensite transformation. The amount of the fcc phase decreased to 9%, while the percentage of the bcc martensitic phase increases to 91%.