

Stellar AD730®

Powder for Additive Manufacturing



MATERIAL OVERVIEW

- Stellar AD730® is an innovative nickel-based superalloy designed to withstand high temperatures (750° C/1382°F) while preserving strength, creep and fatigue resistance.
- The chemical composition has been optimized in order to be easily processable by powder bed fusion, to reinforce the matrix for better hot tensile strength owing to the high substitution element content.

Metallurgical characteristics: solid solution strengthening of γ matrix by refractory elements (Mo and W), reduced Co content compared to 720 Alloy, strengthening provided by γ' phase and high microstructural stability.

KEY PROPERTIES

| | | | |
|---|--|-------------|------|
| Mechanical ¹ (750°C) | Yield strength (MPa) | Z | 885 |
| | | XY | 970 |
| | Ultimate tensile strength (MPa) | Z | 1033 |
| | | XY | 1088 |
| | Elongation at failure % | Z | 19 |
| | | XY | 7 |
| | Area reduction at failure % | Z | 22 |
| | | XY | 5 |
| Thermo-physical ² (316-871°C) | Thermal conductivity (W(m°C) ⁻¹) | 11.0 - 26.0 | |
| | CTE (Linear)/ x10 ⁻⁶ °C ⁻¹ | 12.8 - 16.4 | |
| Physical ² | Density/ g cm ⁻³ | 8.23 | |
| | Melting range/ °C | 1280-1360 | |

¹ All measurements are for the sub-solvus heat treated alloy. Strain rate of 10⁻⁴ s⁻¹.

² Data taken from conventional Brochure AD730®:
https://www.aubertduval.com/wp-media/uploads/2017/05/2017_Brochure_AD730.pdf

CHEMICAL COMPOSITION

| | Ni | Fe | Cr | Co | Mo | W |
|------|------|-----|----|----|-----|---|
| Mini | Base | 3.6 | 15 | 8 | 2.5 | 2 |
| Maxi | | 5 | 17 | 10 | 3.5 | 3 |

| | Al | Ti | Nb | B | Zr | C |
|------|-----|-----|-----|-------|------|------|
| Mini | 2.0 | 3.3 | 0.8 | 0.005 | - | - |
| Maxi | 2.5 | 3.9 | 1.4 | 0.02 | 0.05 | 0.04 |

POWDER CHARACTERISTICS

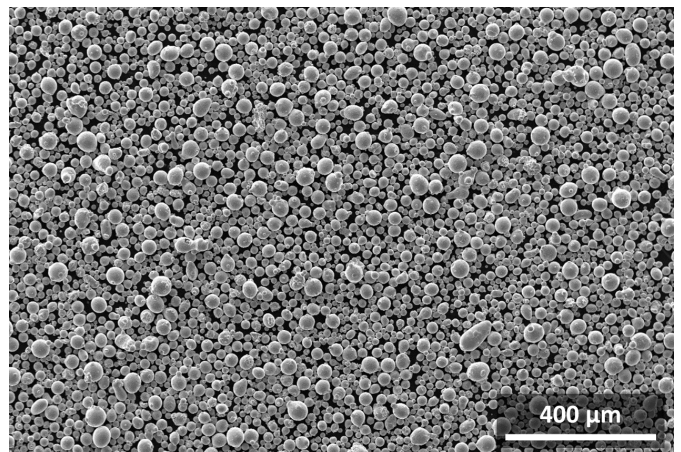
Particle size distributions:

Laser Beam Melting (powder bed): 15-53 μm

Electron Beam Melting (powder bed): 45-106 μm

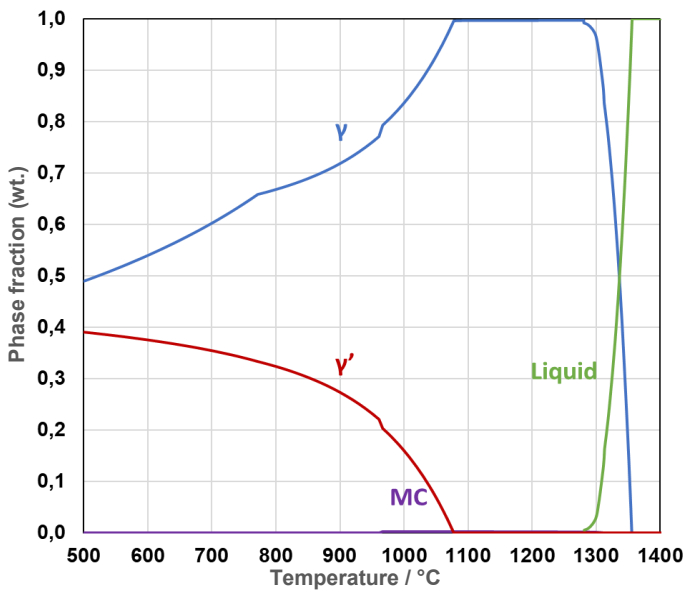
Directed energy deposition (LMD): 45-106 μm

Custom size distributions available on request



Stellar AD730® is developed for VIM gas atomization and available for R&T and full production. Typical powder morphology.

PHASE FRACTION BY THERMOCALC & DTA



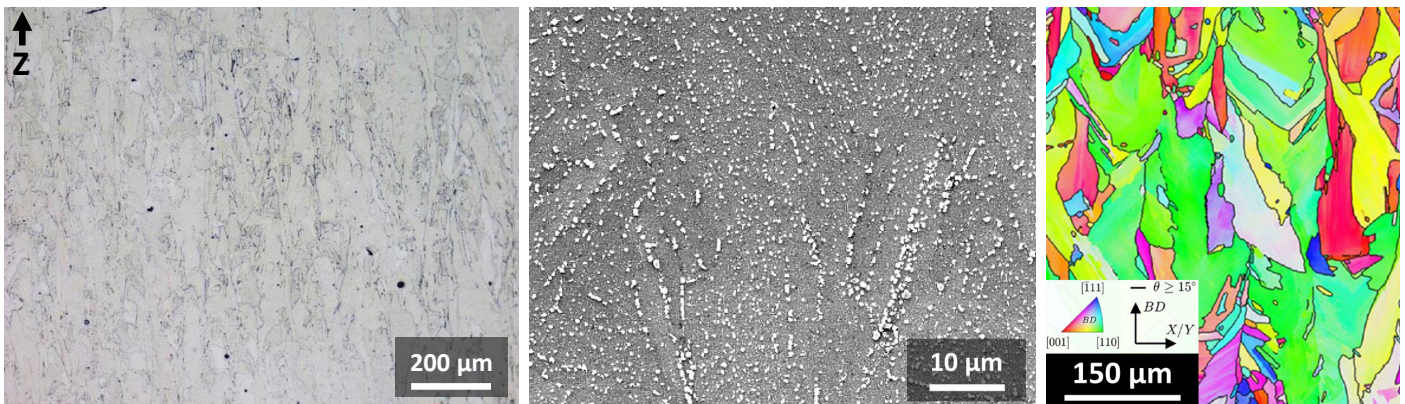
| Phase | TTNI8 | DTA |
|----------------|-------|------|
| Liquidus (°C) | 1355 | 1343 |
| Solidus (°C) | 1280 | 1254 |
| γ' solvus (°C) | 1080 | 1102 |
| MC Solvus (°C) | 1312 | 1332 |

Equilibrium phase fraction versus temperature for AD730® calculated by Thermo-Calc with TTNI8 database.

Liquidus, solidus and solvus temperatures for γ' and MC phases from calculation and Differential Thermal Analysis (DTA) measurement.

MICROSTRUCTURE & HEAT TREATMENT

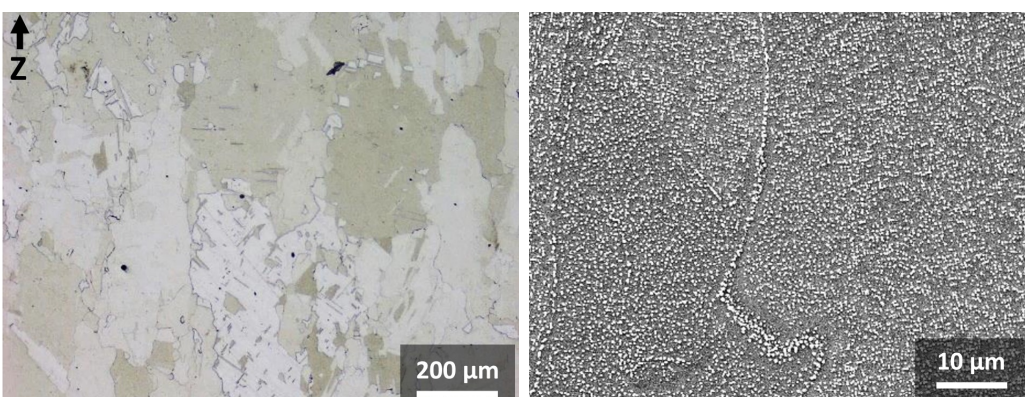
Standard sub-solvus heat treatment: 1080°C/4h/Air cooling + 760°C/16h/Air cooling



Optical and SEM images & EBSD BD-IPF map after standard sub-solvus heat treatment.

Grain size: XY: 5-5.5 ASTM.

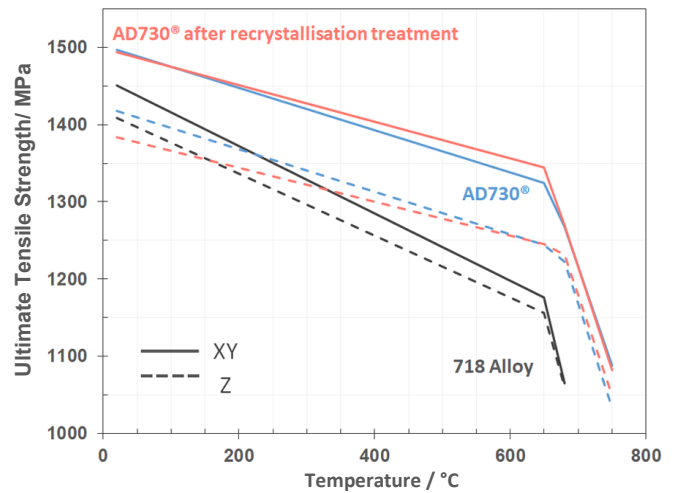
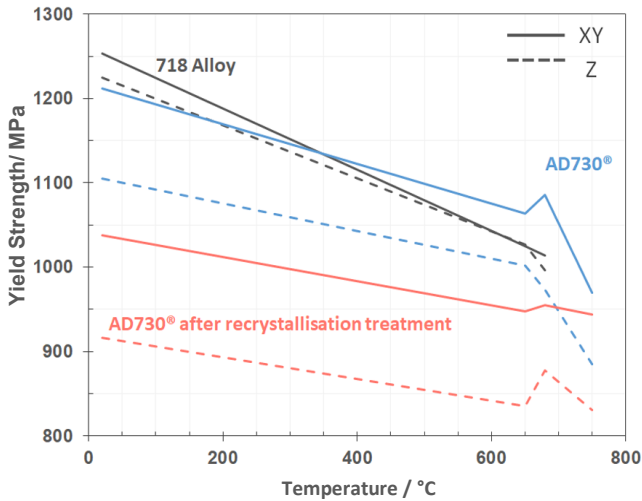
Recrystallisation heat treatment: 1180°C/2h/Air cooling + 1080°C/4h/Air cooling + 760°C/16h/Air cooling



Optical and SEM images after recrystallisation heat treatment.

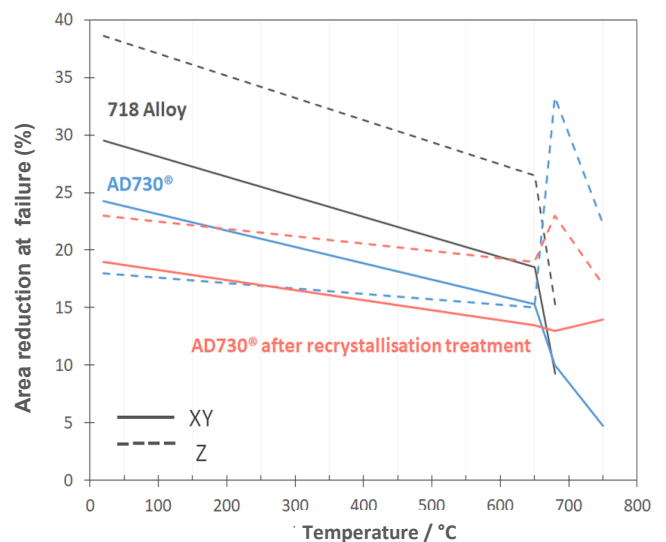
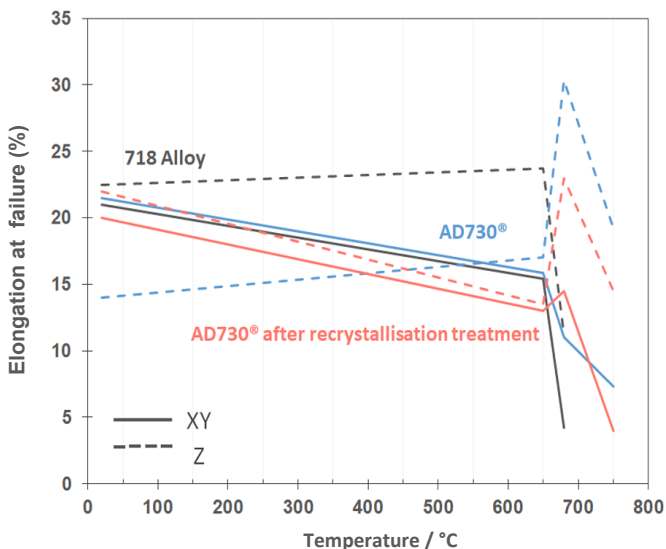
Grain size: XY: 3-3.5 ASTM; Z: ~ 2 ASTM.

TENSILE PROPERTIES



Tensile properties of additively manufactured Stellar AD730® after standard sub-solvus and recrystallized heat treatments. Alloy 718 is additively manufactured and fully heat treated. No HIP applied. Properties evaluated at a strain rate of 10^{-4} s^{-1} , all other test conditions in accordance to NF EN 2002-1 and NF EN 2002-2. Yield Strength (YS) shown is Rp0.2% stress, Ultimate Tensile Strength (UTS) is stress at maximum force.

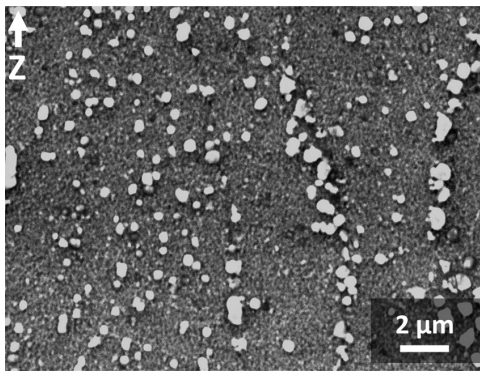
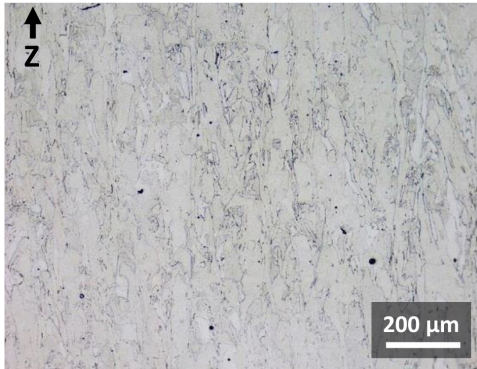
TENSILE DUCTILITY & REDUCTION OF AREA



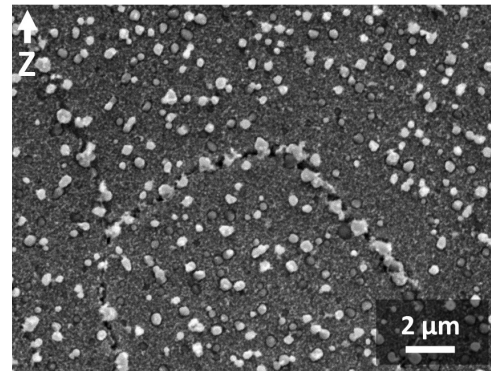
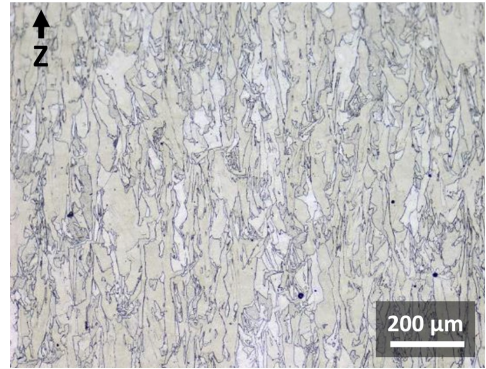
Tensile properties of additively manufactured Stellar AD730® after standard sub-solvus and recrystallized heat treatments. Alloy 718 is additively manufactured and fully heat treated. No HIP applied. Properties evaluated at a strain rate of 10^{-4} s^{-1} , all other test conditions in accordance to NF EN 2002-1 and NF EN 2002-2. Elongation and Area Reduction were measured after failure as per the standards.

Contact: powder@eramet.com
www.aubertduval.com

MICROSTRUCTURE STABILITY



Optical and SEM images after sub-solvus treatment.

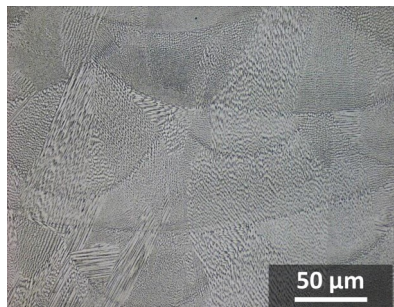
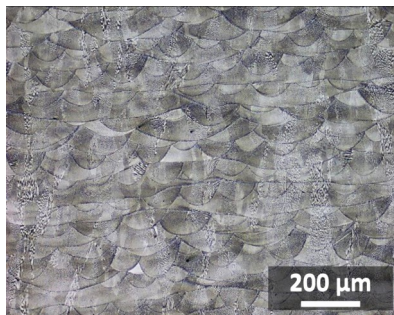


Optical and SEM images after sub-solvus treatment + heat exposure 50h at 800°C.

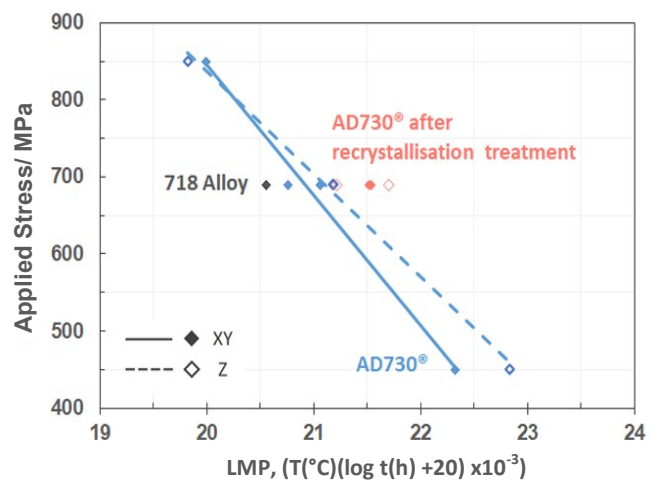
No significant evolution of the microstructure after heat exposure.

PRINTABILITY

Excellent metallurgical health after SLM process with Stellar AD730® powders (Reference EOS M290, optimized parameters, layer thickness: 40μm)



STRESS RUPTURE PROPERTIES



Stress rupture properties of additively manufactured Stellar AD730® after standard sub-solvus and recrystallisation heat treatment. Tested in accordance to ISO 204. Larson Miller Parameter evaluated with Temperature (T) in Celsius and Time (t) in hours. Alloy 718 is additively manufactured and fully heat treated.

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