
Supporting Information

Progress and Challenges of Additive Manufacturing of Tungsten and Alloys as Plasma Facing Materials

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Supplemental Tables

Table S1. A list of suppliers and powder types used in Ref [3].

Powder type	Supplier
Spheroidised 225 W powder, W -25	Tekna Advanced Materials Inc.
Partially spheroidised W powder	Global Tungsten & Powders Corp
Polygonal W powder, HC 4000	H. C. Starck GmbH,

Table S2. Operating ranges of Laser powder bed fusion, direct energy deposition, electron beam melting, and wire arc additive manufacturing. Adapted from Ref. [26].

	LPBF	DED	EBM	References
Particle size (μm)	5–50	50–150	20–105	[165,166]
Source Power (W)	10^2 – 10^3	10^2 – 10^4	10^2 – 10^3	[26,167]
Cooling rate (K/s)	10^5 – 10^7	10^2 – 10^5	10^3 – 10^4	[26,168]
Temperature gradient (K/m)	10^6 – 10^7	10^4 – 10^6	10^4 – 10^5	[26,169,170]
Beam Size (μm)	30–200	10^2 – 10^3	10^2 – 10^3	[26,171,172,173]
Scanning speed (mm/s)	10 – 10^3	10 – 10^2	10 – 10^3	[26,174,175]
Environment	Ar, N ₂	Ar	Vacuum, trace He	[26,176,177]
Spattering	Yes	No	No	[26,178]
Material Waste	High	Minimal	High	[26]
Pre-Sintering	No	No	Yes	[26]
Pre heat temperature (K)	0–1273	0–773	0–1528	[3,101,136]

Supplemental Figures

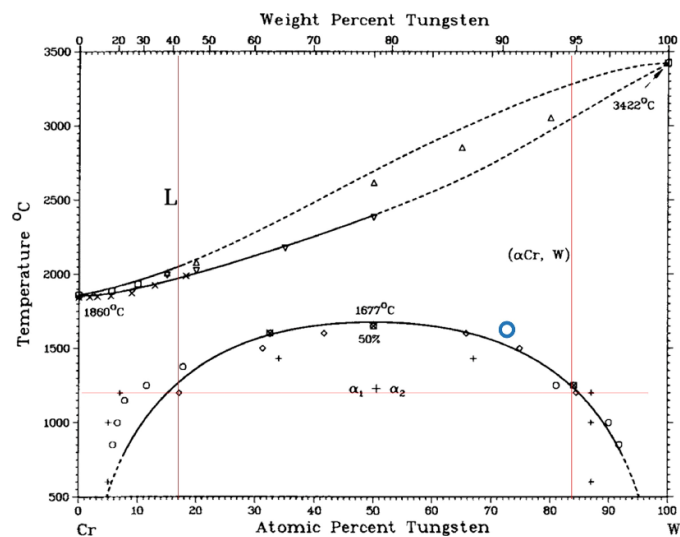


Figure S1. A W-Cr phase diagram [179]. Reprinted from Ref. [179]. with permission; Copyright Elsevier 2016.

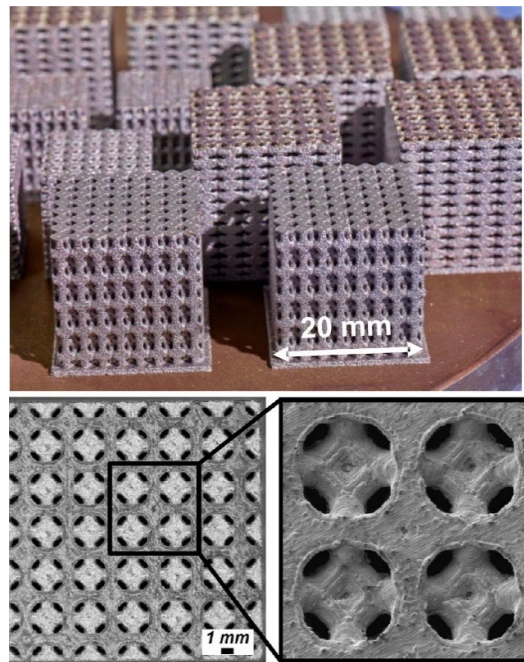


Figure S2. Complex AM W lattice structure samples. Reprinted from Ref. [6]. with permission; Copyright Elsevier 2022.

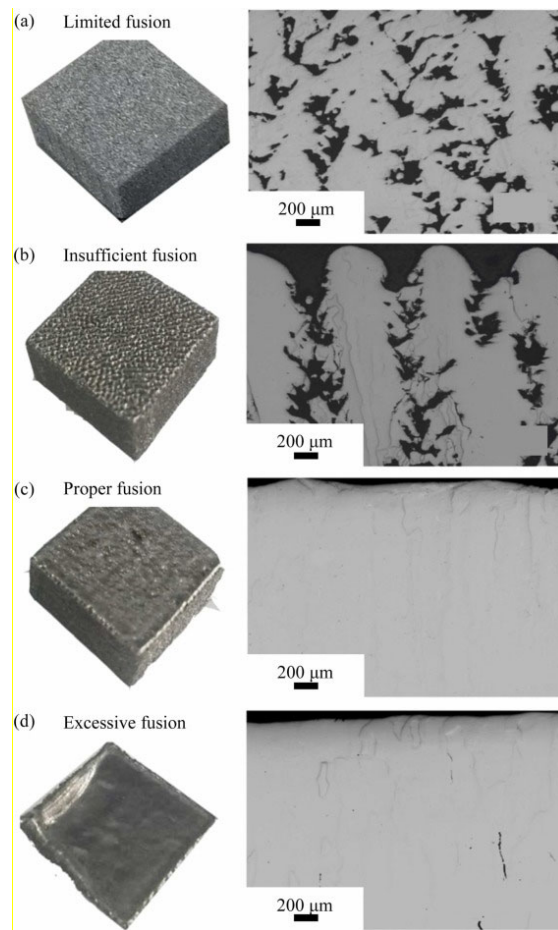


Figure S3. Observed states of pure tungsten fabricated through EBM using different parameters. (a) Limited fusion, (b) insufficient fusion, (c) proper fusion, and (d) excessive fusion. Reprinted from Ref. [90]. with permission; Copyright Elsevier 2019.

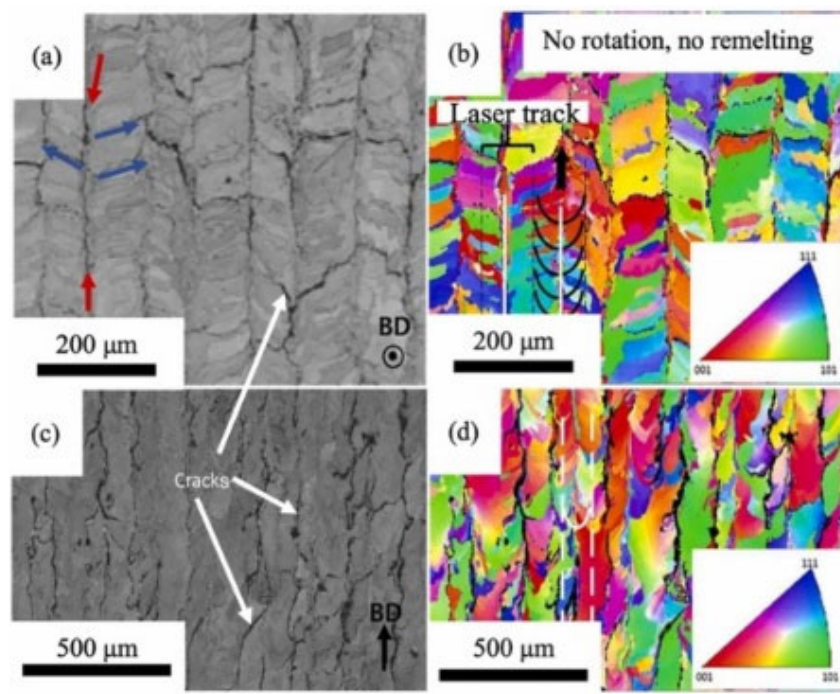


Figure S4. Electron backscatter diffraction (EBSD) images of two sides of a L-PBF W sample showing surface cracks. **(a, c)** As-printed W cross sections on different axes. Longitudinal, branched, and parallel build direction (BD) cracks are visible (red and blue arrows). **(b, d)** EBSD inverse pole figure (IPF) maps of **(a, c)** showing ladder-shaped grains, cracks along grain boundaries and laser tracks. Reprinted from Ref. [88]. with permission; Copyright Elsevier 2018.

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