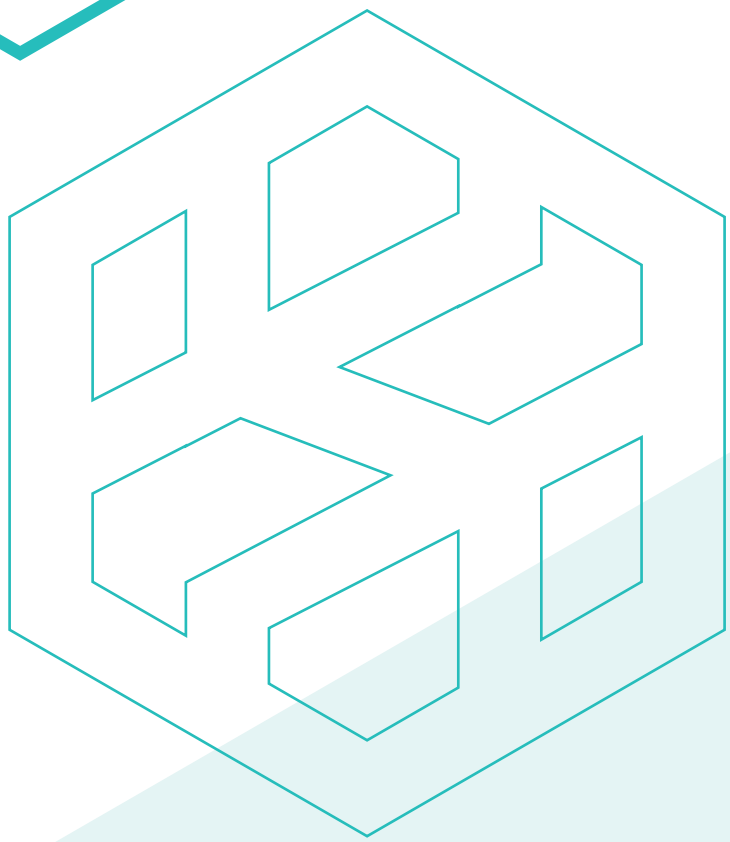
holdson
DYNAMIC ELECTROCHEMICAL SOLUTIONS



TUNGSTEN ENERGY

CASE STUDY

ELECTROCHEMICAL POLISHING

CASE STUDY

THE CHALLENGE

In nuclear energy applications, lattice structures are commonly used as heat sinks due to their excellent thermal management properties. However, for the lattices to function effectively, smooth surfaces within the complex structure are essential to allow optimal fluid flow, which is critical in regulating temperature and maintaining system stability.

Holdson was approached by a leading nuclear energy research and technology organisation (RTO). The client operates within a performance-critical nuclear environment, where geometric precision and material integrity are essential parameters.

The client had explored traditional post-processing methods but these proved to be inadequate for such a complex structure, as they could not achieve the required smoothness in internal channels.

Before processing, the tungsten lattice part presented a surface roughness of 8µm Ra, which posed a significant challenge in terms of fluid dynamics and thermal properties. Achieving a smoother surface finish would be necessary to maximise the part's heat dissipation capabilities and enable reliable fluid flow through its intricate channels.

Input surface finish	8µm Ra
Manufacture method	SLM printed
Material	Tungsten (99.9% pure)
Weight	CONFIDENTIAL
Dimensions	CONFIDENTIAL
Required output surface finish	2 µm
Required processing cycle time	<30 minutes

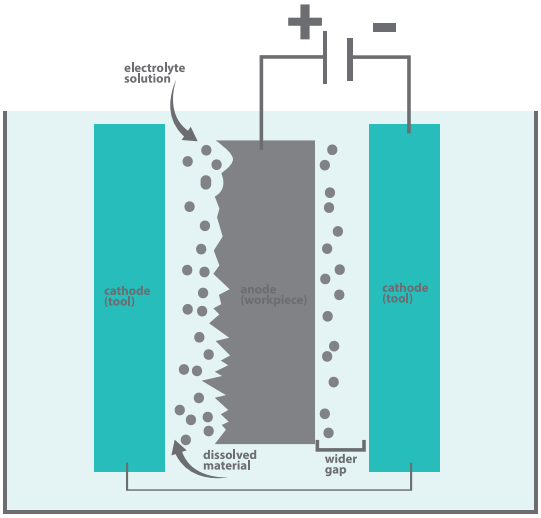
THE SOLUTION

Holdson's electrochemical polishing (ECP) technology has the ability to deliver uniform, repeatable results on intricate geometries and internal structures, such as those found in lattice configurations and so this was selected as a likely solution.

ECP's non-mechanical, acid-free approach allows for precise surface refinement without introducing thermal or mechanical stresses, which is particularly beneficial for brittle materials like tungsten.

The Holdson process, deployed in its range of electroform™ machines, leverages advanced Computational Fluid Dynamics (CFD) to ensure rapid, uniform polishing throughout the lattice structure, meeting the client's requirements for both time efficiency and surface quality. The CFD aspect of electroform™ in particular provide to be critical in improving fluid flow in this case, which directly impacts the heat dissipation performance of the lattice in its high-temperature nuclear environment.

The client's samples were polished in Holdson's ef-150 machine using its ef-Tu electrolyte fluid, which is custom formulated for enhanced material removal on tungsten parts. The process works by uploading a CAD design to the e electroform™'s advanced Nitere control system and then automatically applying carefully controlled parameters to components which are submerged in the electroform machine's electrolyte bowl. During the process, the electrolyte solution is agitated by the machine's CFD technology, which optimising key fluid parameters including direction, pressure and temperature. The outcome is a carefully controlled and / or uniform material removal from the component according to the requirements agreed with the customer at the outset of the process.



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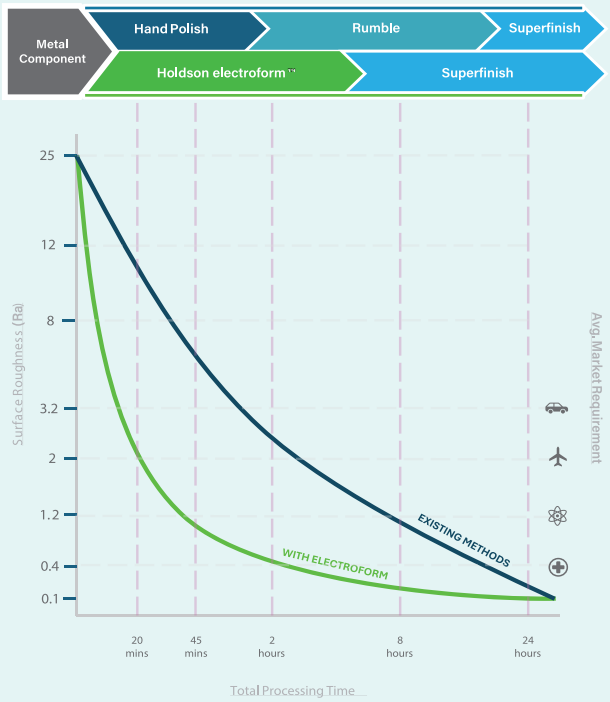
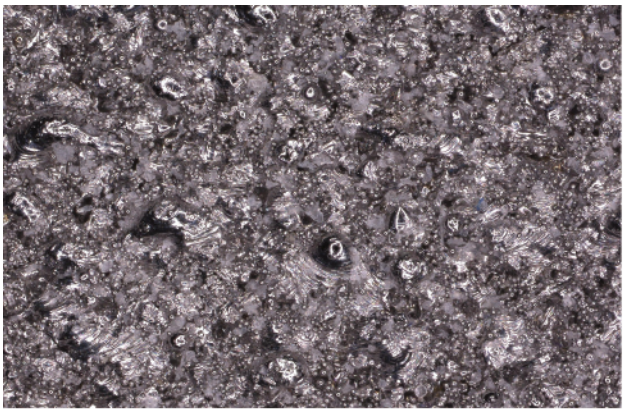


Holdson's process allows for the acceleration of processing times, reducing cost and increasing throughput of post-processing for metal components.

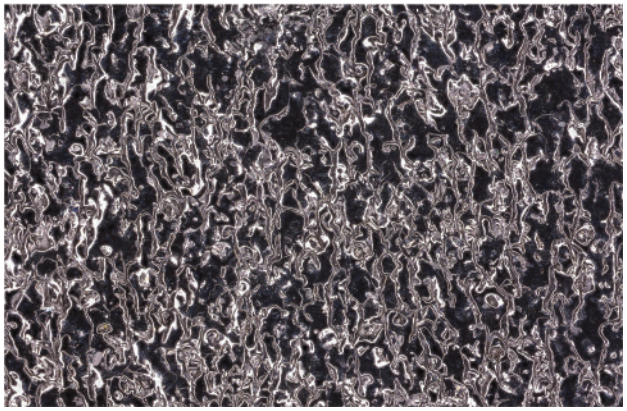
Compared to traditional steps and competitors, Holdson's system can take a metal component at any input roughness and provide a rapid surface improvement within 20 minutes.

THE RESULT

PRE POLISH MICROSCOPE



POST POLISH MICROSCOPE



In this instance, electroform™ successfully reduced the surface roughness of the customer's tungsten lattice component from an initial 8µm Ra to a polished finish of 2µm Ra, meeting stringent quality standards within a rapid 20-minute cycle time.

As a result, the functionality of the component was significantly enhanced, due to the smoothing of internal channels critical for optimising fluid flow and thermal management within the lattice structure.

The more uniform surface also minimised friction, enhanced heat dissipation, and ensured consistent performance under the demanding conditions of a nuclear energy application. This improved finish was considered essential for maximising the component's heat sink capabilities and contributing to overall operational efficiency.

Input surface Roughness	Output surface Roughness	Required cycle Time	Actual cycle Time
8 µm Ra	2µm Ra	<30 minutes	20 minutes

To experience the results of electroform™ for yourself, contact us today at: sales@holdson.co.uk.

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