Plasma Etching Oxide from Nb/Hf (C103) Refractory Alloys for AM Powder Recycling

A proprietary plasma etching process efficiently removes surface oxides from refractory metal powders, enabling cost-saving reuse in additive manufacturing and sustainable material reclamation.

Purdue University researchers have developed a novel method for recycling refractory metal powders, which are commonly used in high-temperature applications such as rocket nozzles. This innovative approach enables the efficient removal of oxide layers that can make these metals unusable. The system uses a proprietary plasma etching process to selectively remove surface oxides, allowing for the reuse of previously unusable powder. This method reduces waste and costs while preserving the integrity of the metal, making it an attractive solution for additive manufacturing. The benefits of this technology include minimizing environmental impact and maximizing material efficiency. It has the potential to be applied to other alloys and could provide a sustainable solution for the recycling of refractory metals.

Technology Validation:

Surrogate oxidation experiments produced a 25â€“150 nm amorphous NbOâ‚‚ layer, enabling plasma etching tests. Using high-GWP gas (SFâ‚†), oxide removal was achieved within 10 minutes, though some over-etching of the metal occurred. Preliminary results suggest low-GWP gases like argon may also be effective. Oxygen content analysis confirmed significant oxidation, validating the need for surface treatment. Despite some non-uniformity, the oxide etches faster than the metal, indicating the process can be optimized for efficient and sustainable powder reuse.

Publication:

https://serdp-estcp.mil/projects/details/4ceea986-2c34-454a-8165-ed4df3a1ba2a/recycling-of-refractory-alloy-powders-via-surface-etching-in-metal-additive-processes

Advantages:

Technology ID

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Category

GreenTech/Circular Economy & Waste Reduction
Materials Science & Nanotechnology/Advanced Functional Materials
Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

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-Efficient Oxide Removal

-Enables Powder Reuse in Additive Manufacturing

-Reduces Material Waste and Cost

-Compatible with Multiple Alloys

-Potential Use of Low-GWP Gases for Sustainability

Applications:

-Additive Manufacturing Powder Recycling

-Aerospace and Defense Components

-High-Temperature Metal Fabrication

-Sustainable Manufacturing and Materials Engineering

-Refractory Alloy Processing and Reclamation

TRL: 3

Intellectual Property:

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