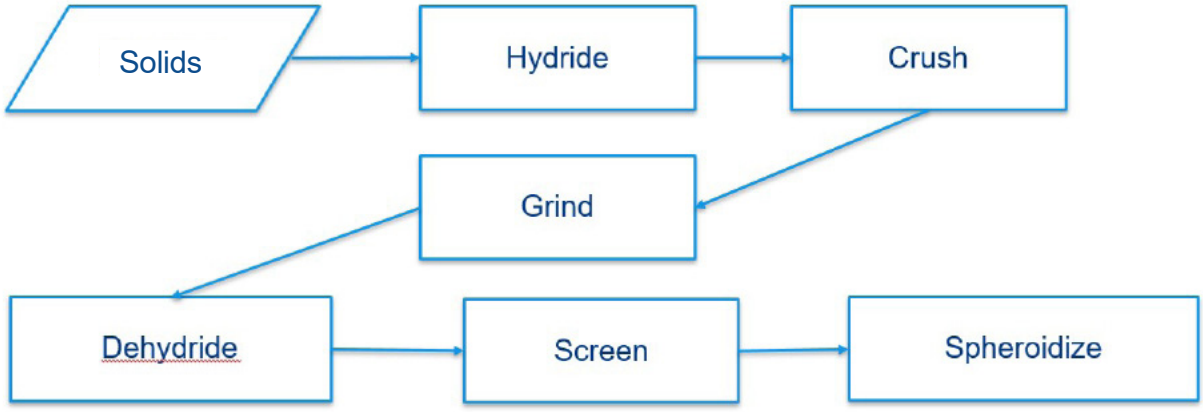
PROJECT SUMMARY 5535.001

Maturation of HDH Powder Production Study



Powder manufacturing workflow under assessment to produce HDH and spheroidized HDH C103 metal powder.

PROBLEM

Niobium powder is commonly produced using the electrode induction melting gas atomization process (EIGA). While the process offers a reliable means of producing high-quality, spherical niobium alloy powders, yields within the laser powder bed fusion (LPBF) powder size distribution range (15–50 micron) offer opportunities for improvement. Alternative methods of manufacturing and process improvements are under evaluation to assess powder cost, yield, and quality. This effort looks to assess a novel hydride-dehydride (HDH) powder manufacturing process which presents the potential for higher yield. Powders from the HDH process are typically angular. LPBF processes often require spherical powder feedstock to promote favorable bed packing density and powder flowability. In this project, the team will focus on the ability to produce a C103 niobium alloy powder via the HDH process with and without spheroidization. Powders will undergo grinding and screening as necessary to derive a size distribution common to LPBF processes (15-50 micron).

OBJECTIVE

The purpose of this study is to determine if the contamination level for niobium alloy powders processed via the HDH route using laboratory-scale equipment and novel production practices can achieve similar levels of contamination (e.g., <300 ppm oxygen) compared to powders processed using current state-of-the-art Electrode Inert Gas Atomization (EIGA). This effort is informing government and defense entities on the possibilities and limitations of producing HDH niobium alloy powders with regards to contamination levels and viability of scale-up for use in additive manufacturing technologies requiring a particle size distribution of 15-50 µm.

AMERICA MAKES TECHNOLOGY DEVELOPMENT ROADMAP

This project aligns to:

MATERIAL

ASTM PROCESS CATEGORY
Powder Bed Fusion

EQUIPMENT
Powder Hydriding, Vacuum Furnace, Plasma Spheroidization

MATERIAL
HDH C103 Niobium Alloy Powder

TECHNICAL APPROACH

Most of the proposed project is focusing on identifying the processing steps having the greatest impact on contamination pickup. Compositional analysis of the alloying and trace elements include Nb, Ta, Hf, Zr, W, Fe, Al, Ni, Co, V, Cr, and Cu, and are being measured after each processing step where there is an assessed potential for contamination. Oxygen, nitrogen, carbon, and hydrogen interstitials are of most interest and are measured after every processing step. Oxygen can be difficult to measure when the material is in hydride form so appropriate uncertainty is being communicated. The processing steps of interest include the initial C103 feedstock, hydriding, crushing, grinding, dehydriding, screening, and spheroidizing (optional).

PROJECT START DATE

November 2022

EXPECTED END DATE

June 2023

EXPECTED DELIVERABLES

- 20 lbs. of HDH C103 powder
- 4 lbs. of spheroidized HDH C103 powder
- Powder chemical composition analysis results
- Preliminary analysis of processing yields, cost, and scale-up
- Final report

FUNDING

$225,000 total project budget
($225,000 public funding)

PROJECT PARTICIPANTS

Project Principal:
ATI Materials

Other Project Participants:
NCDMM/America Makes

Public Participants:
U.S. Department of Defense