Contract No:

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Recycling and Reuse of Tungsten-Rhenium Refractory Alloy Powder for Additive Manufacturing

Project: WP23-3711

QUARTERLY PROGRESS REPORT

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Prepared for: Strategic Environmental Research and Development Program
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1.0 SCOPE

Savannah River National Laboratory in partnership with 6K Inc is working on demonstrating laser and electron-beam powder bed additive manufacturing processes of W-24Re alloy and developing powder reconditioning (deoxidation) technology via plasma spheroidization and investigating the properties and performance of additively manufactured W-24Re components produced using both virgin and recycled powders.

2.0 PROGRESS

Task 1: *Development of laser powder bed fusion (L-PBF) and electron beam powder bed fusion (E-PBF) of W-24Re alloy*

The objective of this specific task is to optimize the L-PBF and E-PBF process parameters for producing crack-free W-24Re coupons with a density >99%. During this reporting period, 5 kg of tungsten powder have been received for optimizing L-PBF process parameters via a comprehensive design of experiments. Figure 1 shows the powder particle morphology and particle size distribution of as-received tungsten powder for L-PBF experiments. Powder particle size distribution analysis has been completed and powder sample found to be very spherical with near normal distribution and circularity more than 0.99. It should be noted that the very spherical powder particle morphology is the best for L-PBF process. SRNL is in the process of developing a research subcontract with 6K Inc, who will produce and provide W-24Re alloy powder for both L-PBF and E-PBF experiments.

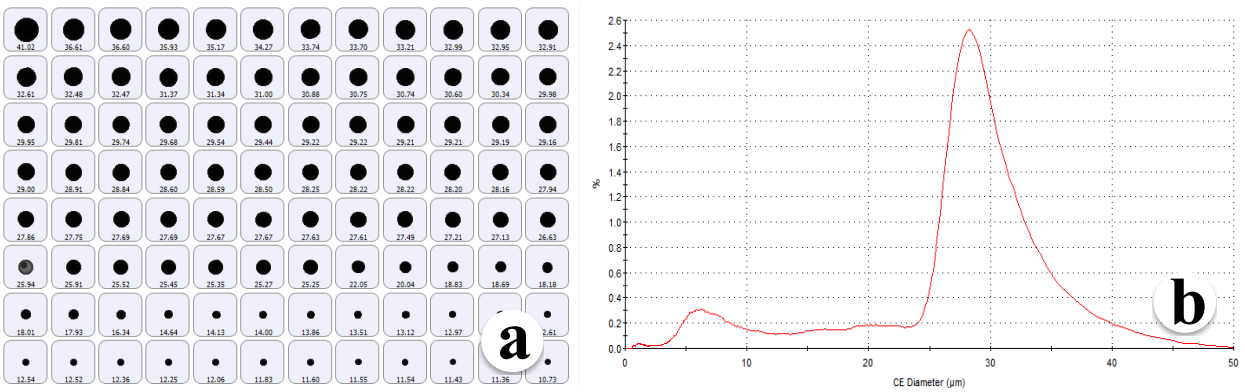

Figure 1: Powder particle size distribution of as-received tungsten powder produce by plasma spheroidization. (a) Typical powder particle morphology with circularity more than 0.99, and (b) a near normal distribution of powder particles with mean diameter of 27 microns.

A comprehensive design of experiments has been carried out to optimize L-PBF process parameters of pure tungsten. Figure 2(a) exhibits the design of experiments matrix for L-PBF of tungsten powder. Note that 36 tungsten coupons were successfully deposited with different combination of laser power and scanning speed, as shown in figure 2(c). Currently, the research team is in the process of preparing metallographic samples of all 36 coupons for microstructural analysis of as-deposited tungsten. The results found from the L-PBF process of pure tungsten will be a good starting point for conducting experiments for investigating the feasibility of laser

additive manufacturing of W-24Re alloy because the physical and thermodynamic properties of pure W and W-24Re alloy are similar.

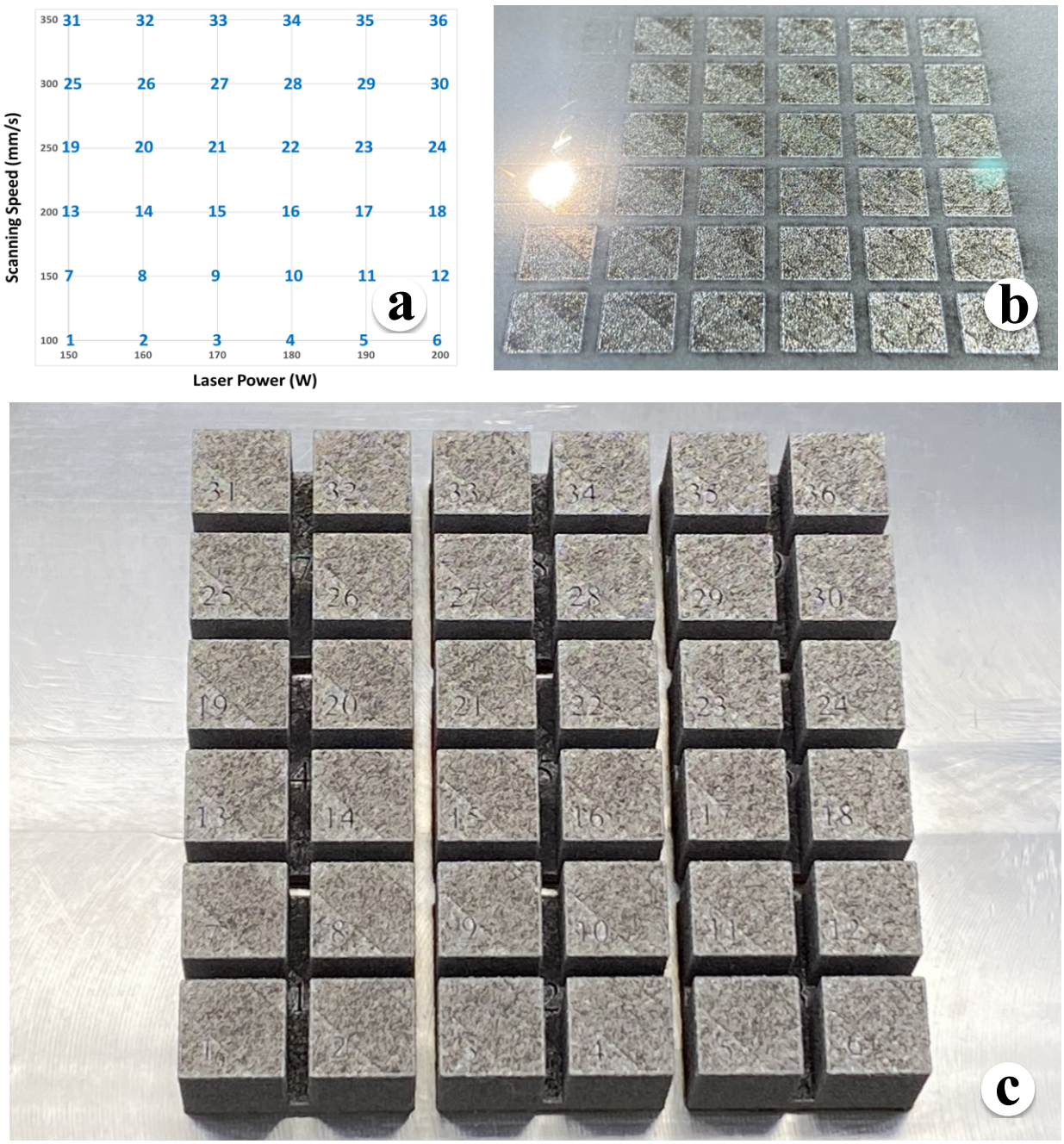

Figure 2: (a) Design of experiments matrix for process parameter optimization for laser powder bed fusion (L-PBF) of pure tungsten powder, (b) L-PBF is in action, and (c) 36 tungsten coupons deposited with different combination of laser powder and scanning speed as shown in figure (a).