Conventional and Flash Sintering of Tungsten and Tungsten Alloys Prepared by Robocasting of ALD-doped Precursors

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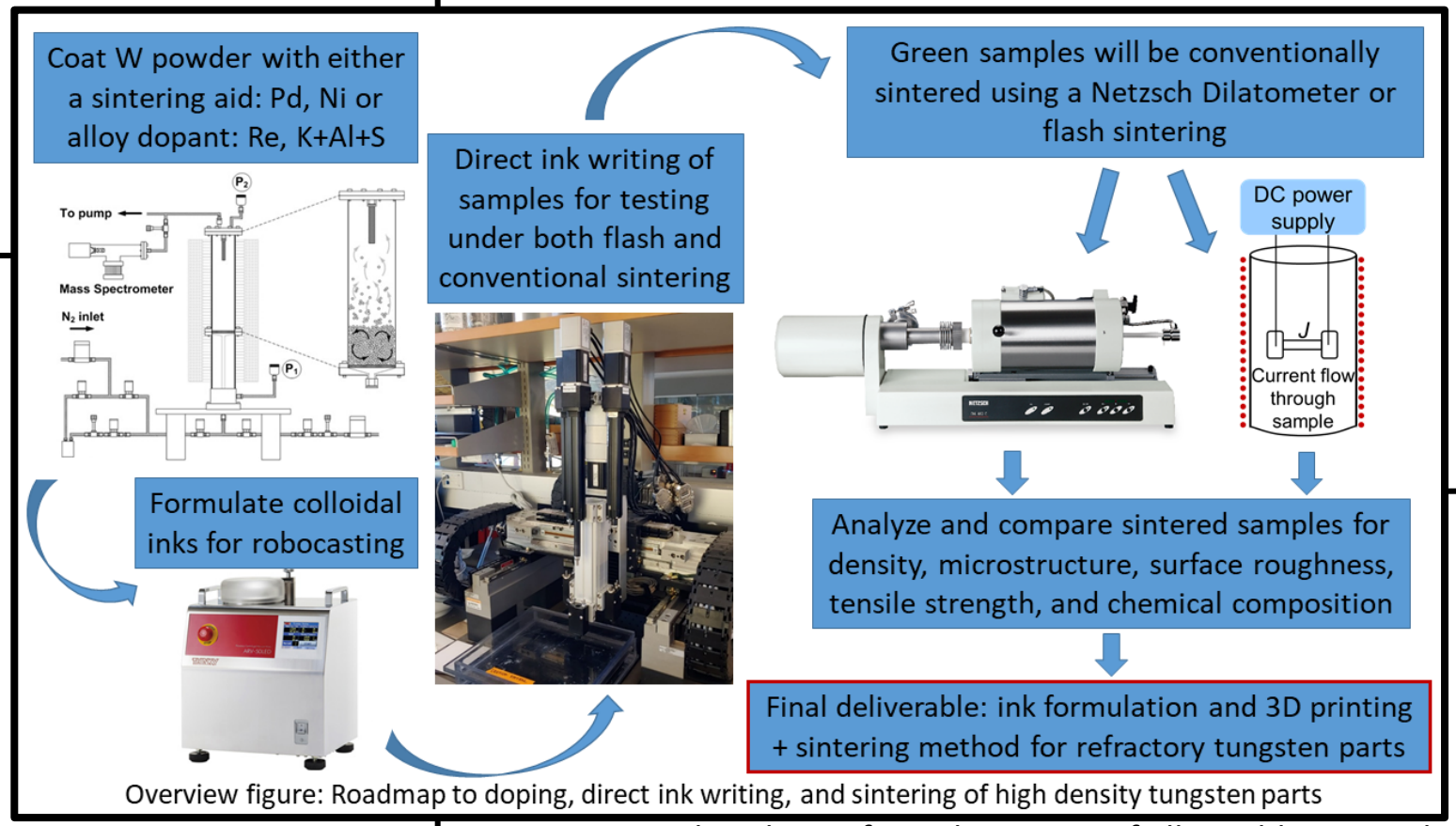
Research Objectives

- Robocasting at room temperature avoids the steep thermal gradients and resulting residual stress of the current SOA: powder bed fusion and flash sintering greatly decreases the sintering time and furnace temperature
- Use ALD to uniformly distribute additives throughout W powder to improve final microstructure
- Flash sinter green bodies to achieve high final density
- This project will bring the technology from TRL 2 (speculative) to TRL 3 by proof of concept of high density, high strength AM tungsten parts from ALD powder

Approach

- Coat W powder with sintering aids or beneficial dopants
- Formulate gel colloidal inks from W powder
- Robocast samples for both conventional and flash sintering
- Sinter samples and characterize final density, surface roughness,
- microstructure, strength, chemical composition, and contact angle
- To modify hydrophobicity, add external ALD coating and test using the sessile drop method



Overview figure: Roadmap to doping, direct ink writing, and sintering of high density tungsten parts

Potential Impact

- Flash sintering of ALD coated W will greatly reduce the required processing time of AM refractory materials
- We expect that the uniform dispersion of alloy additives and sintering aids will improve pinning of grains and inhibit growth to improve final mechanical properties of AM parts including tensile yield and ultimate strength
- This success will enable AM of tungsten parts for high temperature applications such as NTP engines, re-entry systems, and terrestrially in nuclear reactors and jet engines