Coating Core-shell Cermets for Nuclear Thrust Propulsion Fuel Protection

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  - Scott O'Dell
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Research Objectives:

- Aim: Demonstration of core-shell cermet coating of W and W-ZrC on surrogate oxide fuel powders. Quantification of thermal and hot hydrogen stability via testing and 3D multi-scale characterization
- Innovation: To date, coatings are done by CVD. Program here will develop a PVD process and overcome prior line-of-site deposition limitations moving traditional 2D planar deposition to 3D morphology coverage.
- TRL: PVD process has been shown to work in limited DoD material needed applications with demonstrated scalability. Program will expand to new coating types and particulate substrates.

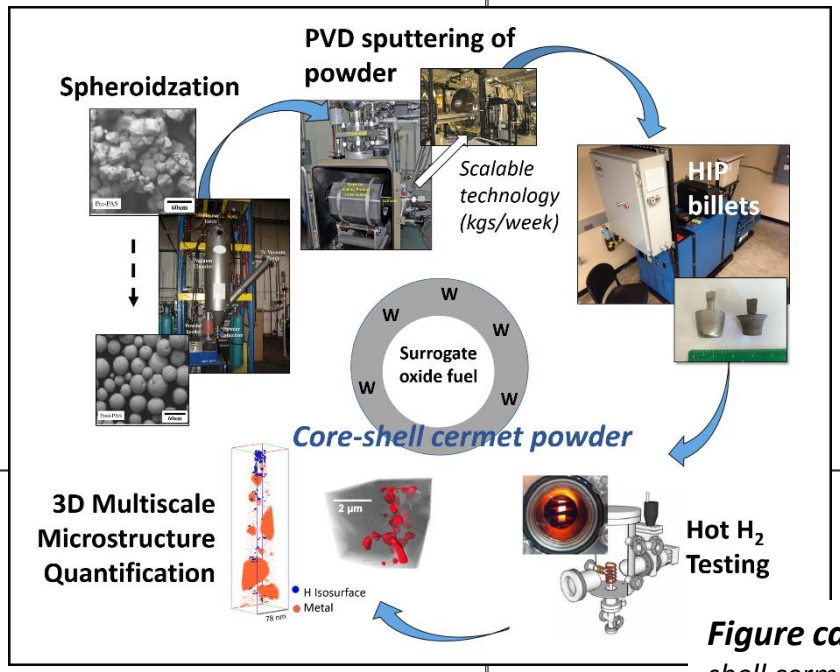

Figure caption: *Program development to coat core-shell cermet powders*

Approach:

- Collaboration with Plasma Process will spheroidized ZrO_2 and CeO_2 powders.
- Powders will then be magnetron sputtered at Exothermics in unique rotating cathode/drum system sputtering system for uniform coating of individual powders.
- Core-shell cermet powders will then be HIP'ed into billets at UA
- Billets (and individual powder beds) will be thermally cycled and hot hydrogen tested
- Billet and powders will be nano/micro-structure will be quantified. Specific tailored experiments will quantify deuterium (^2H) tracer atom concentration levels and spatial positions in coating

Potential Impact:

- Development of a new coating option for cladding nuclear fuel cell oxides, via direct fabrication of core-shell cermet powders
- Legacy knowledge of fine grain coated powders have improved fuel survivability. To date, the underlying material structure-property-performance has not been identified. Modern microscopy tools will elucidate the underlying mechanisms through this research.
- Unprecedented characterization of hydrogen (via ^2H tracers) migration in coatings. Forward feeding information needed for kinetic based diffusion models.