Low Cost Fabrication of ODS Materials

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Motivation
The next generation of heat exchangers need to operate at higher temperature and pressure.

Why don’t we have ODS Products?

Manufacturing Cost - multistep process to make semi-finished products
- The high cost of ODS alloys and components is partially driven by the multistep, batch process of fabrication from powder to final product form
- Traditional ODS materials prepared by MA routes are expensive because of sequential small batch processing. If volume demand was there, parallel processing could lower cost but the last ODS available, PM2000, was $400 lb, reflecting the basic chicken-egg problem.

There are challenges associated with post processing, fabrication, microstructure control / stability
- ODS alloys can be hard to form, bend, pierce, draw, or punch due to inhomogeneously that results in anisotropy, oxide stringering, and, in some alloys, low RT ductility.

Are there alternative process routes that can remove the some of the costs and produce the right microstructure and workability when going from powder to semi-finished product?

Mechanically Alloyed Powder Gas Atomized Powder Steel Powder + Y2O3

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TEM shows similar size dispersions in the SHAPE processed pucks as in conventionally processed MA956
- Small 5 to 20 nm dispersions are Al-Y-O and Y-O
- The SHAPE process may be able to make the right microstructure in one process step

Texture and elimination of mechanical anisotropy

Grain size less than 5 microns and oriented 45deg to the extrusion axis
- The texture direction is influenced by the ratio of the rotation rate to the extrusion rate
- In ODS alloy that have secondary recrystallization behavior, this may allow for growth of elongated grains in a unique (spiral) direction in the tube/pipe

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