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Steam Oxidation Resistant Ceramics for SiC Protection

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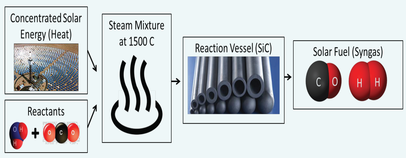
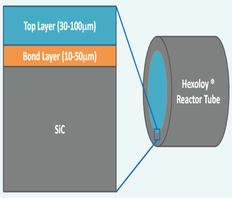


Enable solar fuel reactors in 1500°C steam – need high temp. components such as SiC

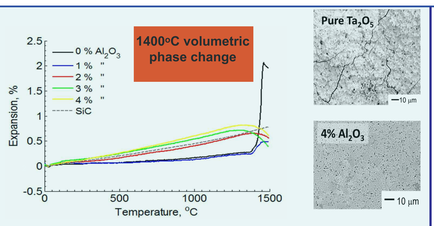
Steam oxidation protection for SiC

Variable	State of the Art	Current Targets
Service Temperature	1400°C	1500°C
Pressure	1 atm	<1 – 15 atm
Gas Velocity	>10 m/s	<1 m/s
Intended Service	Combustion (gas turbines)	Synthetic fuel reactors w/steam
Desired Lifespan	>10,000 hours	>200 solar cycles

Proposal: Ta_2O_5 Coating on SiC

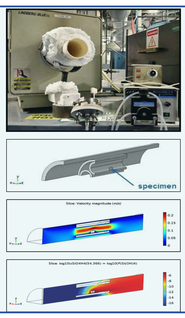


Ta_2O_5 stabilization

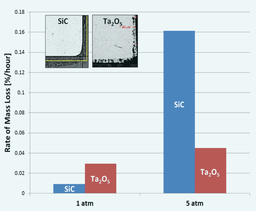


Conclusions: 4% Al_2O_3 can stabilize Ta_2O_5; thermal expansion matches SiC well

Steam Testing



Steam Recession Result



Conclusion: Stabilized Ta_2O_5 (4% Al_2O_3) can protect SiC only at high pressure

Summary

- Ta_2O_5 exhibits volumetric phase change at 1400°C but can be avoided with 4% Al_2O_3 addition
- Thermal expansion behavior of stabilized Ta_2O_5 matches SiC well
- Recession performance inferior to SiC at atmospheric pressure, but superior to SiC at 5 atm
- Development of Ta_2O_5 and other environmental barrier coatings (EBC) for SiC is in progress

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