



n-MCrAlY Bond Coats for Thermal Barrier Coatings



George E. Kim



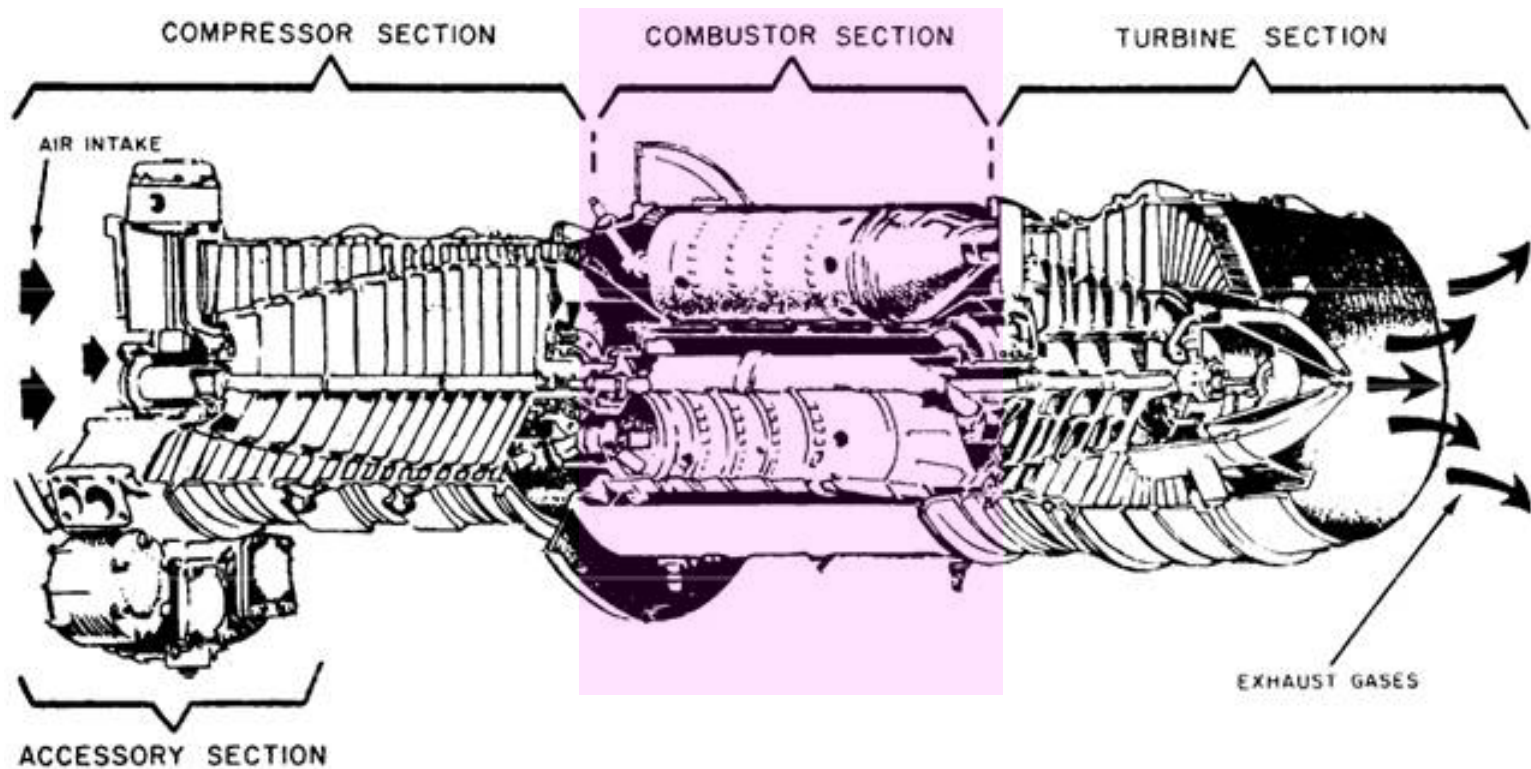
Julie Schoenung et al.



Virgil Provenzano

*Supported by United States Office of Naval Research
(Contract no. N00014-03-10146)*

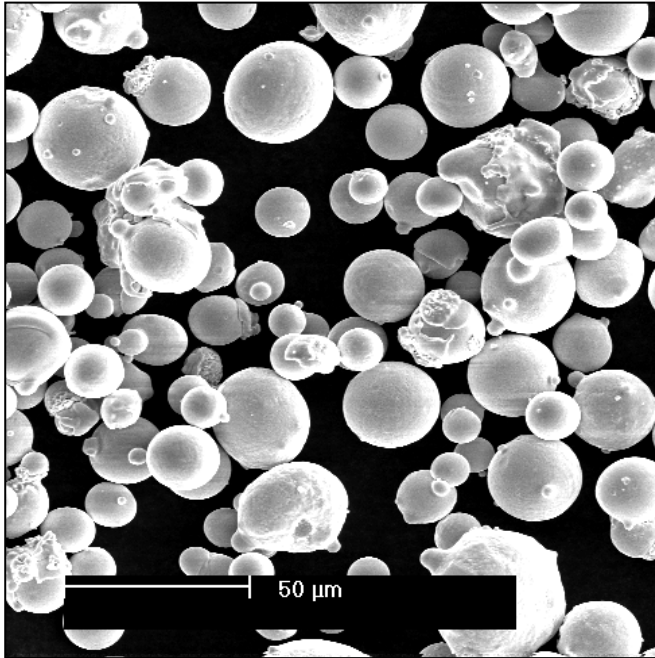
Dr. Lawrence T. Kabacoff – Program Officer



“To produce and analyze the effects of nanostructured bond coat on TBCs”

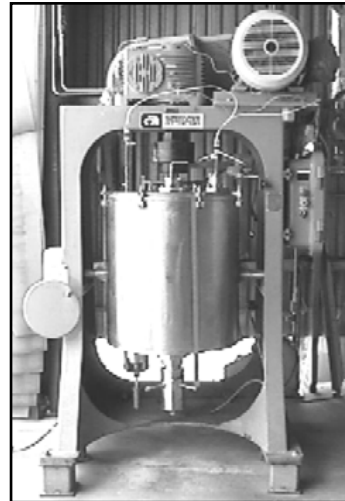
EMPHASIS ON:

- processing of nanocrystalline MCrAlY powder via cryomilling
- deposition of fine-grained bond coat
- TGO structure and composition
- oxidation and thermal cycling performance
- mechanism(s) for difference, if any

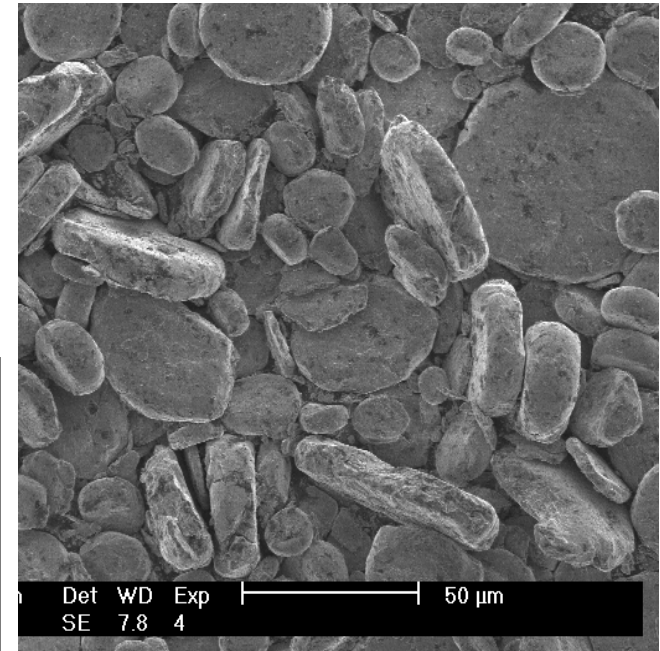


conventional NiCrAlY powder

- avg. particle size: 30 μm
- avg. grain size: 1 μm

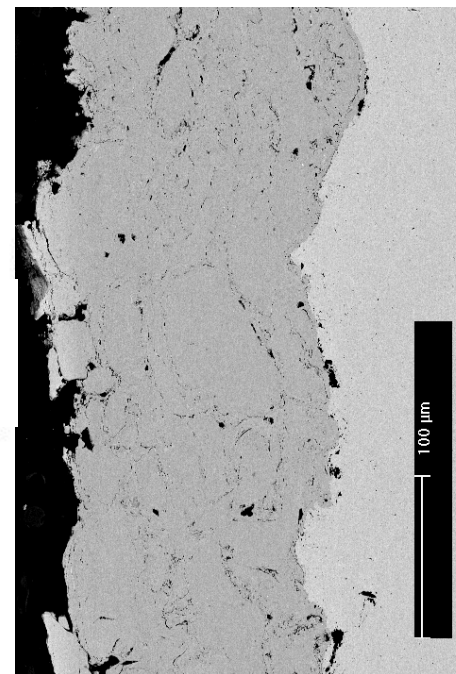
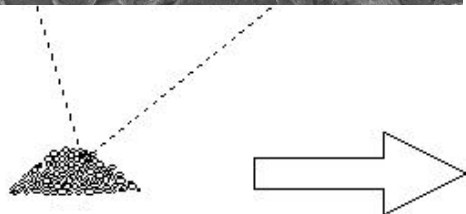
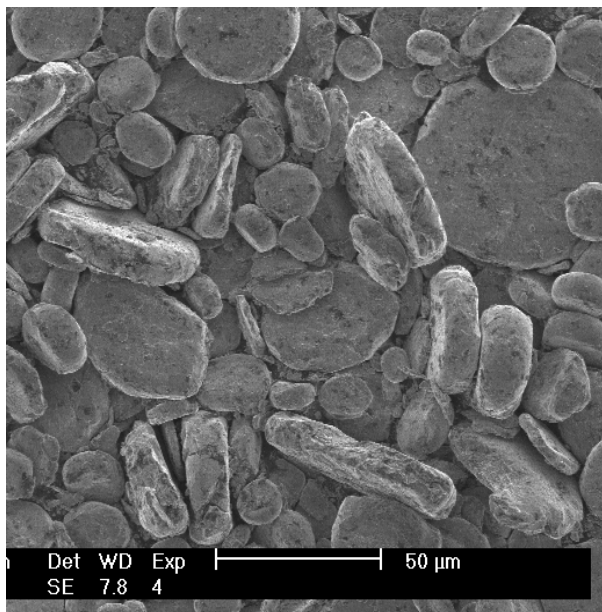


**cryomilled with
0.635 cm SS balls
for 12 hours**



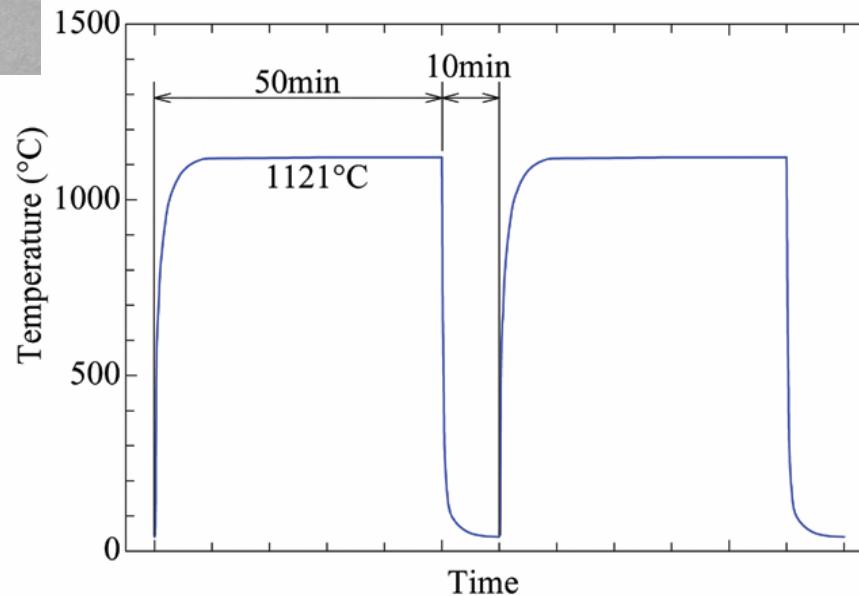
cryomilled NiCrAlY powder

- avg. particle size: 35 μm
- avg. grain size: 27 nm

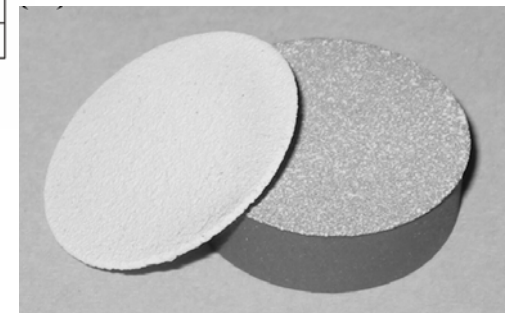




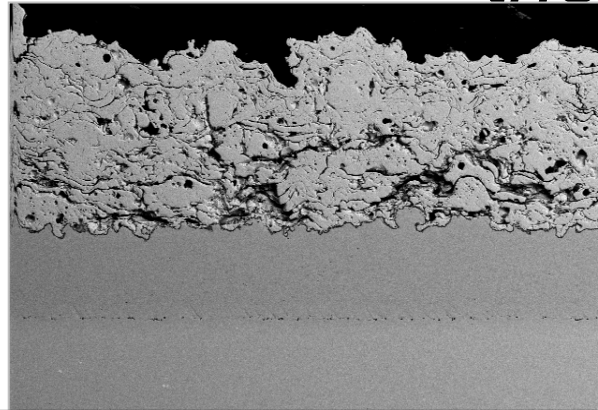
- 1" dia x 1/4" thick IN-718 substrates
- Single side coated with 100 - 150 μm (conv. or nano) NiCrAlY bond coat and 250 - 300 μm YPSZ top coat



Some samples were heat treated at 1080°C in vacuum for 4h before thermal cycle testing.



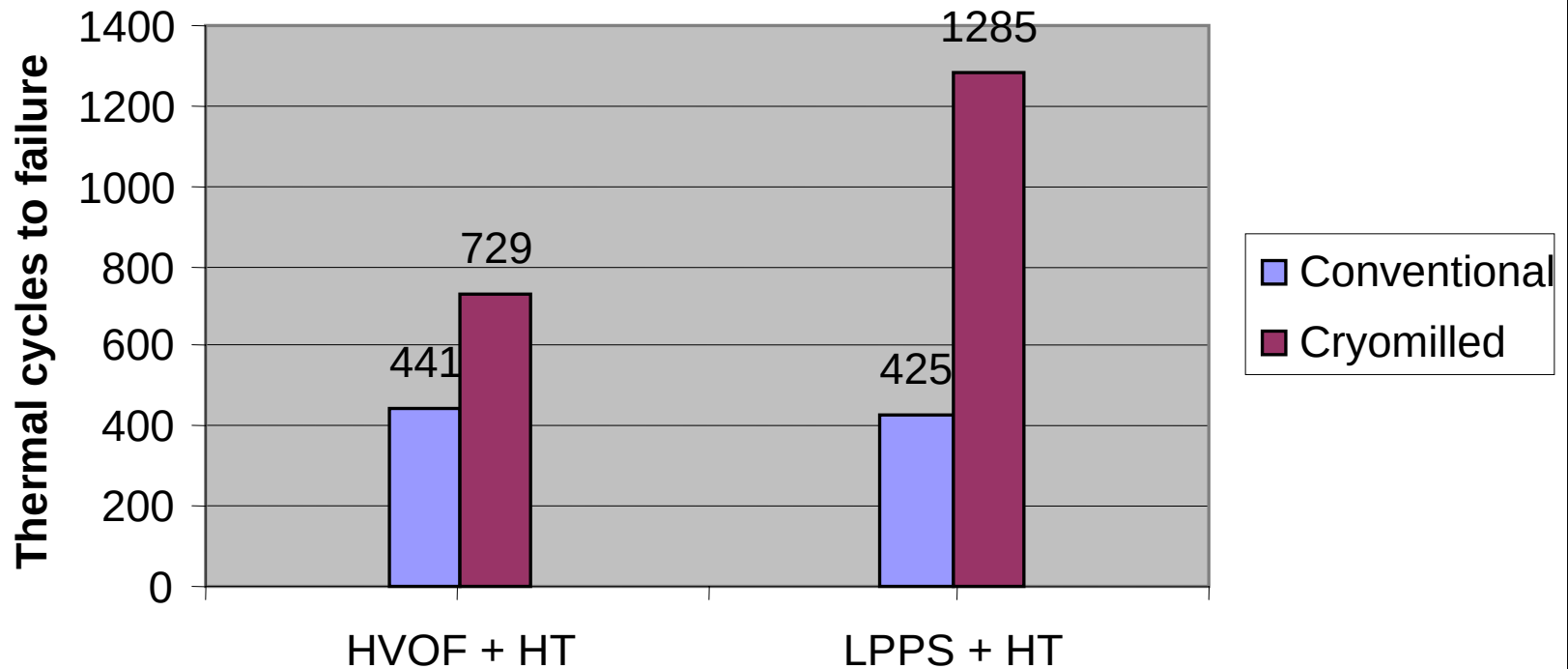
thermal cycling results



APS YPSZ
top coat

HVOF or LPPS
bond coat

substrate



- Cryomilling modified the distribution of the elements and introduced nanometer sized, *in-situ* dispersoids in the as-sprayed bond coat. These changes resulted in changes to the composition, structure, and growth rate of the TGO.
- TBCs with nanostructured bond coats show a notable increase in thermal cycling performance.
- **Currently developing a non-cryogenic milling process through n-WERKZ Inc., for cost-effective powder production.**



Ref:
<http://www.yenra.com/ddx-destroyer-navy/>

POTENTIAL NAVY APPLICATION:

- superior hot-section component performance in land- and aero-GTEs
- **may increase operational and design flexibility of next generation marine gas turbine engine hot-section components by providing superior oxidation and hot corrosion protection**