

# Environmental Barrier Coating

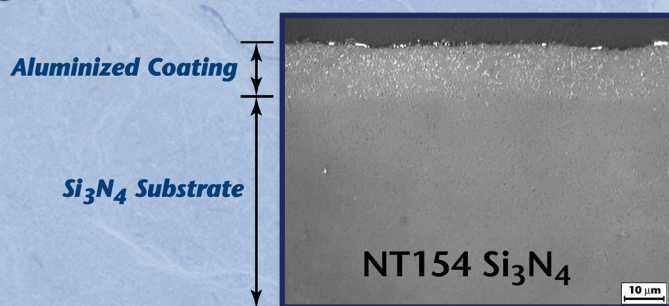
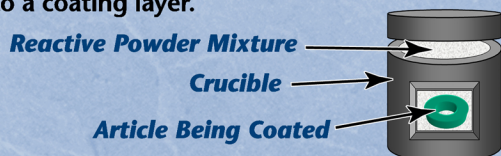
The object of this program is to develop coatings for hot-section components of advanced, high-efficiency microturbines and industrial turbines that resist degradation (surface recession) in high-temperature, high-pressure water-vapor environments.

## Coating Requirements

- Environmentally stable in the presence of O<sub>2</sub> and H<sub>2</sub>O
- Low volatility
- Strong, adherent, and durable
- Matching coefficient of thermal expansion
- Thin and controllable to retain aerodynamics
- Low cost

## Pack Cementation Coating (Low-Cost Process)

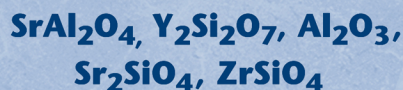
- Complex-shaped components to be coated are embedded in a reactive powder mixture.
- At an elevated temperature, the powder forms a reactive gas that migrates to all surfaces of the complex-shaped part.
- The chemical reaction and diffusion convert the surface of the part into a coating layer.



## Pack Cementation Coating (Variables)

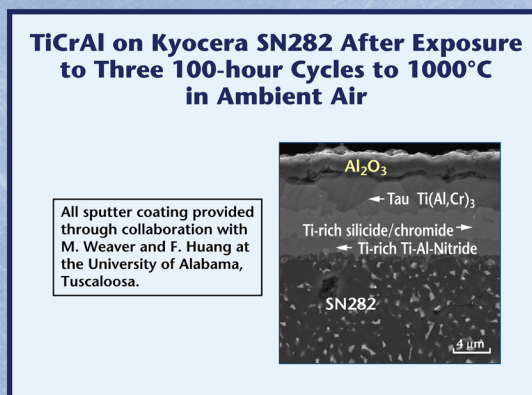
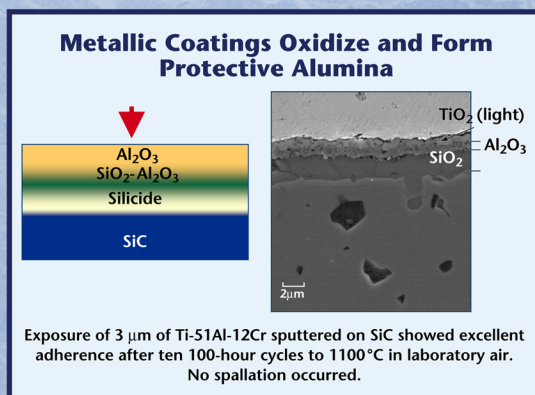
- The coating that is formed during pack cementation depends upon processing time, temperature, atmosphere, composition of the article being coated, and composition of the reactive powder mixture.

- Some of the conversion coating compounds formed on Si<sub>3</sub>N<sub>4</sub> identified by X-ray diffraction analysis.



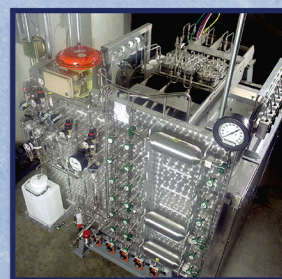
## Al<sub>2</sub>O<sub>3</sub> Forming Coating

- Metallic coatings like TiCrAl are deposited on Si<sub>3</sub>N<sub>4</sub> or SiC and diffuse into the substrate during heat treatment. On exposure to air, the coating oxidizes to form a protective Al<sub>2</sub>O<sub>3</sub> coating or scale.



**Ceramics, Ceramic Composites, and Coatings for Use in Turbine Hot Sections Are Being Evaluated in Simulated Microturbine Environments.**

- Temperatures up to 1500°C
- Pressures to 30 atm
- Low gas velocity (0.1 m/s)
- Water vapor pressures to 4 atm
- Up to ~60 specimens/run (multiple tubes)



**ORNL Low-Flow-Rate, High-Pressure (Keiser) Rig**



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