Environmental Protection Coatings

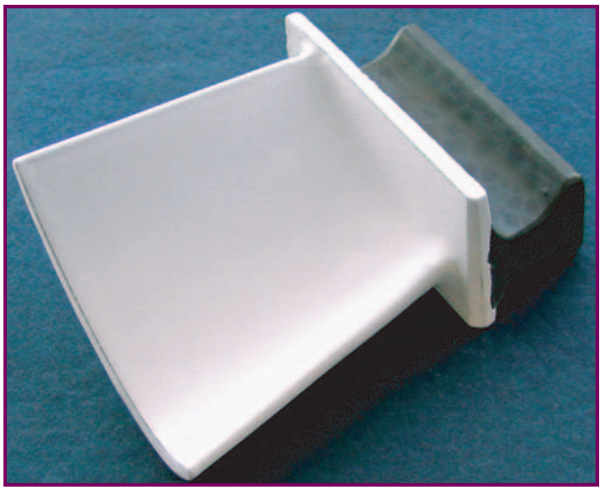
The object of this program is to develop coatings for hot-section components of advanced, high-efficiency microturbines and industrial turbines that resist degradation (surface recession) in high-temperature, high-pressure water-vapor environments.

Coating Requirements

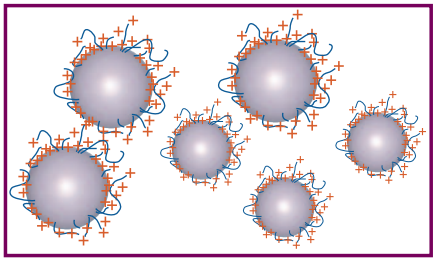
- Environmentally stable in the presence of O_2 and H_2O
- Low volatility
- Strong, adherent, and durable
- Matching coefficient of thermal expansion
- Thin and controllable to retain aerodynamics
- Low cost

Dip (Slurry) Coating Processes for Complex Shapes

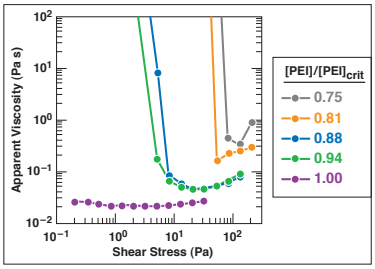
- The dip-coating process can be varied to suit a wide range of ceramics (e.g., mullite, BSAS, zirconia, silicates, and aluminates).
  1. A ceramic powder is mixed with an aqueous or a nonaqueous solvent to form a slurry.
  2. The component is dipped in the slurry.
  3. The coated component is dried and heat-treated to densify the coating.
- Coating quality depends on the rheology and wetting behavior of the slurry.
- The process can be used to patch damaged coatings (e.g., thermal barrier coatings).



Rare earth silicate coating on a complex-shaped component (NT154 Si_3N_4 rotor blade)

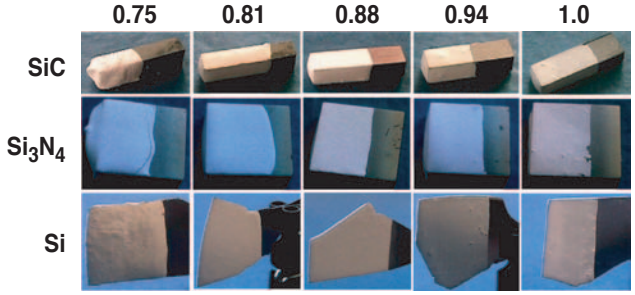


PEI coats negatively charged particles to reduce net interparticle attraction.

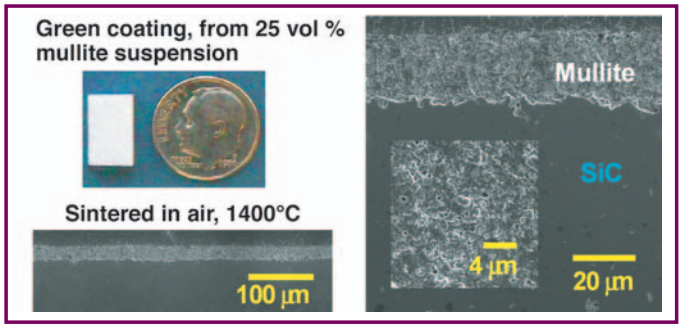


Shear-thinning flow behavior is reduced with increasing PEI addition until Newtonian flow behavior is observed at $[PEI]_{crit}$.

Coatings formed by dipping substrates into mullite slurries (45 vol %) of varying PEI concentrations, $[PEI]/[PEI]_{crit}$



Mullite coating on a silicon carbide substrate



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

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