TBCs for Industrial Gas Turbines

Thermal barrier coatings (TBCs) are a critical materials technology that reduces the operating temperature of internally air-cooled hot-section superalloy hardware. TBCs allow increased turbine inlet temperatures resulting in dramatic improvements in engine performance, efficiency and/or durability.

Key Issues in TBCs for IG Ts
- Coating Manufacturing
- TBC Durability/Reliability
- Alloy/Coating Compatibility

TBC Durability and Reliability: Residual Stress
Round Robin Testing with industrial and university collaborators is being conducted to determine the reproducibility of photo-stimulated luminescence spectroscopy for non-destructively analyzing stress & oxide phase content within TBCs.

Collaborators:
- GE Aircraft Engines
- Howmet Research Corporation
- Siemens-Westinghouse
- Honeywell
- Solar Turbines
- UC-Santa Barbara
- University of Connecticut

TBC Manufacturing: Bond Coat Surface Finishing
Problem: Grit-blasting of (Ni,Pt)Al bond coat surfaces prior to deposition of EB-PVD YSZ alleviates TBC "infant mortality", but also decreases ultimate TBC life.

Result: Sulfur impurities in the (Ni,Pt)Al surface stabilized void formation – CVD process improvements & heat treatments are being developed to remove sulfur.

Summary
Progress has been made in understanding relationships between manufacturing and TBC lifetime, but much additional work is needed in order to guide the design of advanced TBC systems for industrial gas turbines. There is a particular need for improved understanding of TBC failure mechanisms in order to identify practical routes to improved coating durability, reliability and life prediction.