# ARCHITECTURAL DESIGN OF FUNCTIONALLY GRADED THERMAL BARRIER COATINGS (TBC)

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- **Ceramic based coatings** are being engineered to protect metallic components from high temperature environments in applications like diesel engines, gas turbines and jet engines
- **Functionally graded TBCs** have a changing material composition through the coating thickness

## APPROACH FOR DESIGNING DURABLE THERMAL BARRIER COATINGS

- MICROMECHANICS MODELS
  - Estimate effective thermo-elastic properties
  - High temperature viscoplastic response
- FRACTURE MECHANICS ANALYSES

**ANALYTICAL MODELING**

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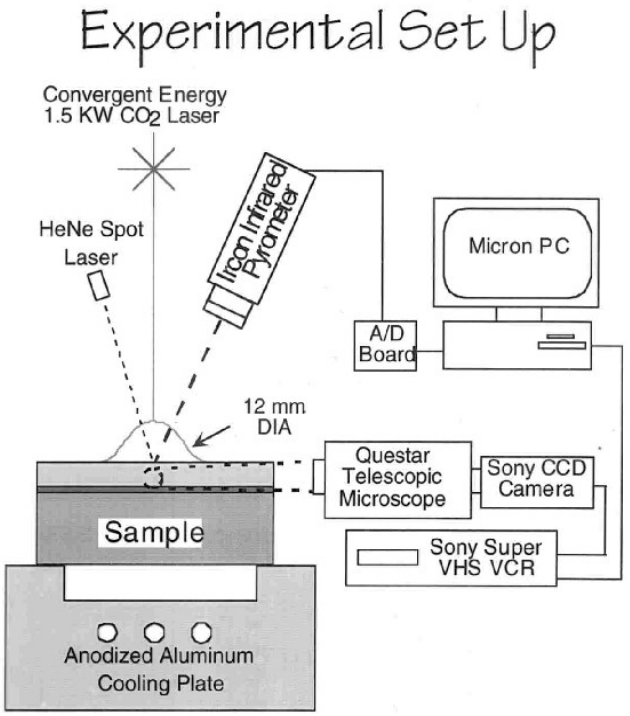
- TBC PROPERTY MEASUREMENTS
- LASER THERMAL SHOCK EXPERIMENTS
- CHARACTERIZING THERMAL FRACTURE: Microscopy, Acoustic emission

**EXPERIMENTS**




**High Temperature Materials Laboratory**

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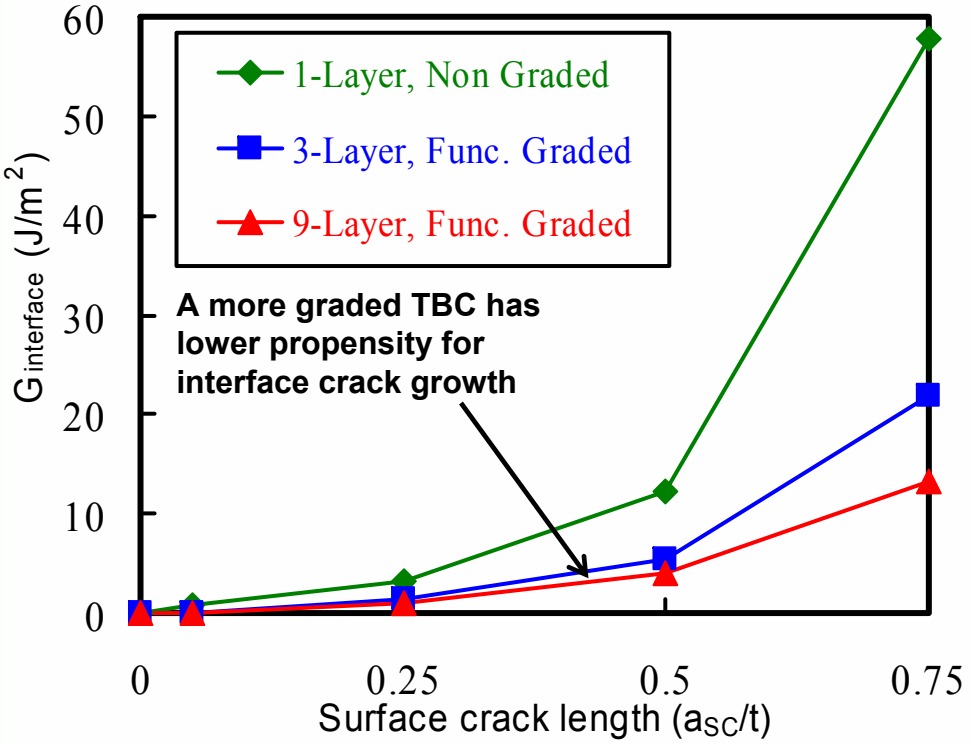
**FUNCTIONALLY GRADED TBC**: Combination of Ceramic (Zirconia) and Bond coat (NiCoCrAlY) alloy

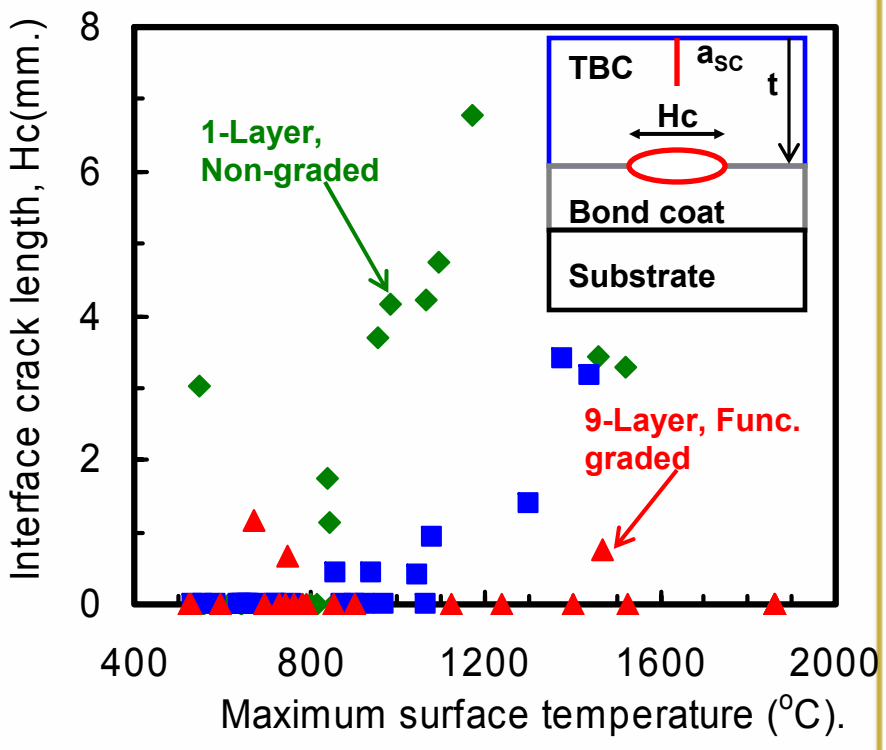
- Ceramic rich near the surface: Thermal insulation from the high temperature environment
- NiCoCrAlY alloy rich near interface: Lower property mismatch, Higher fracture toughness, Corrosion resistance

## ANALYTICAL MODEL PREDICTIONS




The energy driving interface crack propagation is **lower** in a **functionally graded TBC**

## LASER THERMAL SHOCK EXPERIMENTS




**Shorter TBC-BC interface cracks** result in a functionally graded TBC