Advanced Ceramic Matrix Composites (CMC) Manufacturing and Machining Process

Objective

Improve the fuel efficiency and reduce the weight of the UH-60 Black Hawk and AH-64 Apache helicopters through the use of lighter weight, higher temperature capable and more durable Ceramic Matrix Composite (CMC) turbine engine components.

How It’s Accomplished

- Manufacturing of sub and full-scale prototype components
- Test to validate process capabilities to MRL6+
- Scale-up and optimize “LEAN” processing and equipment
- High Yield Manufacturing Process:
  Successful preforming, machining, coating trials
- Technologies are to be transferred to Lean Labs in Year 4 and used to produce one set of shrouds (minimum deliverable) for the Army
- Leverages DMS&T Ceramic Matrix Composites; NAVAIR and AF MS&T

Achievements

- Project results will contribute to meeting force capabilities
- Navy slated as first adopter of technology
- Non-Destructive Evaluation (NDE)- Flash IR was developed and is being used as a quality inspection method for coating on CMC parts
- Abradable Slurry- An application method for applying an abradable layer to EBC (Environmental Barrier Coatings) using APS (Air Plasma Spray) has been developed
- Advanced CMC Machining- CMC grinding, increased feed rate (3x baseline) combined with increased wheel speed shows equal or better performance with respect to grind forces, microcracking, and mechanical performance
- Strip and Recool- Methods to strip and recoat EBC have been proven to be viable in extending shroud life

Benefits

- CMC 1st and 2nd stage High pressure Turbine Shrouds (HPT) will be lighter and more durable than metallic HPT shrouds
- Improved power-to-weight margin
- 1% Specific Fuel Consumption (SFC) savings equates to increased mission duration, lower operational costs and increased warfighter safety due to fewer fuel convoys required
- Provides form/fit/function replacement design for new/retrofit applications
- Improved damage tolerance and reduction in recurring costs
- Reduced machining labor hours (20%), preforming (50%), layup & debulk (50%), and tape processing (20%)
- Reduced CO₂ emissions

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