NASA SBIR 2011 Phase I Solicitation

A1.03 Durable Propulsion Components

Lead Center: GRC

The mitigation and management of aging and durability-related hazards in future civilian and military aircraft will require advanced materials, concepts, and techniques. NASA is engaged in the research of materials (metals, ceramics, and composites) and characterization/validation test techniques to mitigate aging and durability issues and to enable advanced material suitability and concepts.

Proposals are sought for the development of physics-based probabilistic fatigue life models for powder metallurgy disk superalloys, which include both crystal plasticity and surface environmental damage modes. The models would capture the evolution of fatigue damage due to crystallographic slip within multiple grains of variable orientation and size, as well as damage due to environmental interactions at the surfaces of compressor and turbine powder metallurgy superalloy disks. This research opportunity is focused on quantifying, modeling and validating each of these damage modes during simple cyclic and dwell fatigue cycles, and then later for simulated service in aerospace gas turbine engine disk materials. Work may involve use of uniform gage and notched fatigue specimens to simulate key disk features, potentially utilizing varied disk surface finish conditions and associated residual stress and cold work. The simulated load history and temperature gas turbine engine conditions should approximate turbine service history reflective of the new generation of gas turbine engines and include the effect of superimposed dwell cycles. NASA will be an active participant in Phase I of the research effort by providing superalloy disk sections, for the proposer to machine into specimens, mechanically test, analyze, and model evolution of these damage modes. Technology innovations may take the form of the unique quantification of the effect of service history on these damage modes, and include analytical modeling descriptions of the evolution of these parameters as a function of simulated service history. The technology innovations may also include models and algorithms extrapolating this damage to service conditions outside of those tested during the program.