A1.01 Mitigation of Aircraft Aging and Durability-Related Hazards

Lead Center: GRC

Participating Center(s): ARC, LaRC

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 moisture-resistant resins and new surface treatments/primers. Novel chemistries are sought to improve the durability of aerospace adhesives with potential use on subsonic aircraft. This research opportunity is focused on the development of novel chemistries for coupling agents, surface treatments for adherends and their interfaces, leading to aerospace structural adhesives with improved durability. Work may involve chemical modification and testing of adhesives, coupling agents, surface treatments or combinations thereof and modeling to predict behavior and guide the synthetic approaches. Examples of adhesive characteristics to model and/or test may include, but are not limited to, hydrolytic stability of the interfacial chemistry, moisture permeability at the interface, and hydrophobicity of coupling agents and surface primers. Examples of adherends to model and/or test include carbon fiber/epoxy composites used in structural applications on subsonic aircraft, and aluminum, as well as their respective surface treatments. Additionally, proposals are sought for test techniques to fully characterize aging history and strain rate effects on thermoset and/or thermoplastic resins as well as on advanced composites manufactured of such resins and reinforced with 3D fiber preforms such as the triaxial braid used in advanced composite fan containment structures. Technology innovations may take the form of tools, models, algorithms, prototypes, and/or devices.

Proposals are sought for the development of validated models to capture the evolution of residual stresses and cold work at machined features of compressor and turbine powder metallurgy superalloy disks. This research opportunity is focused on quantifying, modeling and validating residual stress and cold work evolution at stress concentration features during simulated service in aerospace gas turbine engine disk materials. Work may involve use of notched fatigue specimens to simulate stress concentration features utilizing varied surface finish conditions including as-machined, electro-polished, and shot peened surfaces. 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 the notched specimens, and performing the mechanical testing. Technology innovations may take the form of the unique quantification of the effect of service history on residual stress and cold work depth profile evolutions within notches, 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 the predicted residual stresses and cold work to service conditions outside of those
tested during the program.