Opportunity Title: Fiber Modeling for Thermal Protection Materials
Opportunity Reference Code: 0150-NPP-MAR26-ARC-MatPhysSci

Organization National Aeronautics and Space Administration (NASA)

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How to Apply All applications must be submitted in Zintellect

Please visit the NASA Postdoctoral Program website for application instructions and requirements: How to Apply | NASA Postdoctoral Program (orau.org)

A complete application to the NASA Postdoctoral Program includes:

1. Research proposal
2. Three letters of recommendation
3. Official doctoral transcript documents

Application Deadline 3/1/2026 6:00:59 PM Eastern Time Zone

Description **About the NASA Postdoctoral Program**

The NASA Postdoctoral Program (NPP) offers unique research opportunities to highly-talented scientists to engage in ongoing NASA research projects at a NASA Center, NASA Headquarters, or at a NASA-affiliated research institute. These one- to three-year fellowships are competitive and are designed to advance NASA's missions in space science, Earth science, aeronautics, space operations, exploration systems, and astrobiology.

Description:

Background:

Fibrous materials are critical to spacecraft entry and descent in nearly every NASA mission involving atmospheric entry. Fibers in heat shield materials provide structure and excellent thermal properties in ablative and reusable materials. Like many common insulative materials, fibers can be packed to form a porous network that is used in reusable thermal protection, for example on space shuttle, and ablative materials, for example on Stardust, Mars Sample Laboratory, OSIRIS-REx, and Dragonfly. Weaves enable denser ablative thermal protection materials, used for Mars Sample Return - Earth Entry System, and deployable thermal protection materials, such as ADEPT and LOFTID. Fabric parachutes are crucial for spacecraft many descents after entry. These materials are complex, hierarchical and must protect from extreme environments and phenomena, such as deformation, impact and high-enthalpy heating. Woven material performance depends on microstructure, damage and weave geometry. Therefore, fiber-specific models are needed to simulate fiber contacts within the weave hierarchical geometry (fiber to tow to yarn to weave) and the inherent directionality of fibers.

In woven thermal protection composites, the fiber-, yarn- and weave-scale

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features are leveraged for performance. Changes to manufacturing and component sourcing affects features along those different scales and thus affect performance. Identifying material property dependence due to structure and manufacturing can be used to diagnose challenges, and ultimately support certification and design.

Continuum approaches have been well validated and successfully predict thermo-chemical performance of thermal protection materials under designed conditions. However, what if there is a change in the components, unexpected defects occur in the article, or a new mission requires a new design? In these cases a bottom-up approach with materials models that resolve the influence of each component in the full composite are needed. This opportunity aims to connect fiber-, yarn- and weave-scale structure and physics with thermal protection composite-scale performance.

Objective:

We are seeking proposals to apply and develop simulation techniques to study the role of micro- and meso-structure on the thermal and mechanical behavior of woven materials for thermal protection materials. Proposals should consider the unique features of woven materials. Lagrangian/particle-based simulation (such as bonded particle) and Eulerian (such as finite element) methods can be used. Proposals should acknowledge the benefits and limits of their technique compared to others. Part of the proposal should consider the need of experimental validation and verification of proposed techniques.

After considering the opportunity and developing some ideas, please email the advisor before writing your proposal.

Field of Science: Materials and Physical Sciences

Advisors:

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Questions about this opportunity? Please email npp@orau.org

Qualifications Candidates with a PhD in engineering (chemical, mechanical, and/or aerospace), physics, materials science, and/or geology are encouraged. Experience in particle-based methods is required, methods such as molecular dynamics, discrete element method and bonded-particle model. Experience with granular flow, plume-surface interaction, fracture mechanics, thermomechanical response, and impact are a plus. The selected postdoctoral researcher will have freedom to advance the work to best accomplish the objective. This

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includes freedom to pursue new developments, and to build connections with experimental and computational researchers at and beyond NASA.

Point of Contact Mikeala

Eligibility Requirements

- **Citizenship:** LPR or U.S. Citizen
- **Degree:** Doctoral Degree.