1. **Research Title:** Single Crystal Fiber Development for IR Applications

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Physics, Chemistry, Materials Science Engineering, Electrical Engineering, Optics, or equivalent (MS or PhD level)

4. **Objectives:** Synthesis and/or characterization of single crystal fibers for IR applications.

5. **Description:**

Optical fiber technology has revolutionized the layout of complex optical trains – in some cases eliminating the need for free space optics and reducing alignment issues while simultaneously offering rugged, light-weight, low-maintenance designs. In laser systems, fiber gain media have progressed to relevant power metrics for defense application with high conversion efficiencies and excellent beam quality. However, fundamental material limits of silica-based laser technology hinder further enhancements in power and energy output. Novel fiber gain media based instead on single crystal materials with higher thermal conductivities, damage thresholds, and nonlinear onsets offer promising routes to higher output powers, where the narrower linewidths associated with homogenous single crystal materials lead to greater efficiencies in power scaling.

The current task seeks to develop a single crystal fiber program based on rare-earth substituted garnets and fluorides. These material systems provide both wide transparency and access to excited states of interest (depending on choice of active ion) throughout the SWIR and MWIR. Synthesis efforts will encompass demonstrating control over a broad range of material aspects: chemistries and distributions of active and inactive ions, adherence to fiber geometries, crystallinity – including an analysis of orientation, strain, and defect structures. Standard material characterization techniques will be used alongside custom optic experiments to develop key metrics (losses, efficient light guiding, slope-efficiency, etc.) for evaluating single crystal fiber performance and relating optical figures of merit to underlying fiber designs and properties.

6. **Research Classification/Restrictions:** Unclassified, unrestricted.

7. **Eligible Research Institutes:** DAGSI participating universities