RX18-6

DAGSI Research Topic

1. **Research Title:** Advanced Optical Materials for Next Generation High Powered Lasers
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**

Materials Sciences, Physics (working towards Ph.D.)

4. **Objectives:** Research optical materials for several important emerging high powered laser systems under development for Air Force applications

5. **Description:** High Energy Lasers (HEL) are being developed for next generation Air Force weapon systems. Several different HEL configurations and lasing media are being researched, including optical fiber based as well as various gaseous or vapor based systems. All of these approaches suffer from materials limitations that impede their progress towards implementation in a fielded system. For example, lasers made from optical fiber are still not sufficiently powerful for many industrial and military applications. One reason is that an all-fiber optical isolator is not available with sufficient power handling. Optical isolators absorb harmful back-traveling reflections within an optical fiber system which can harm components on the back end of the high energy laser system. Improved materials are needed, and transparent ceramics (TCs) and perovskite structured materials hold significant promise for developing optical isolators with much higher power handling and lower isolation losses for use with fiber laser amplifiers generating 5 kilowatts of laser power or more. Additionally, Diode Pumped Alkali Lasers (DPAL) operate at an extremely high efficiency and hold promise for use as next generation HELs. However the alkali vapor that is used as the lasing media is very caustic, resulting in a brief lifetime for the laser windows. Currently used window materials are made from quartz which fail above 200°C due to alkali diffusion. TCs and perovskite materials hold promise for use as window and optical coating materials that can resist diffusion at higher temperatures while maintaining optical transparency. A comprehensive research program is needed for studying TCs and perovskite materials for these applications. This research will involve using thin film deposition for materials synthesis and investigating various composition studies of TCs and perovskite materials. Comprehensive characterization and analysis will be required to investigate material composition and morphology, to include x-ray diffraction (XRD), x-ray photoelectron

spectroscopy (XPS), secondary ion mass spectrometry (SIMS), and scanning electron microscopy (SEM) and atomic force microscopy (AFM).

6. **Research Classification/Restrictions:** This research is considered Unclassified.