

Opportunity Title: Phase-change-metasurface-based tunable optical components for next-generation spaceborne applications

Opportunity Reference Code: 0034-NPP-NOV23-LRC-TechDev

Organization National Aeronautics and Space Administration (NASA)

Reference Code 0034-NPP-NOV23-LRC-TechDev

Application Deadline 11/1/2023 6:00:59 PM Eastern Time Zone

Description NASA Langley Research Center in Hampton, VA is seeking a highly talented and motivated postdoctoral candidate to work on phase change material optical devices and metasurfaces. Currently, our team is developing a chalcogenide phase change material (PCM)-metasurface-based integrated actively-tunable filter component.

Our current research objectives include:

1. Developing nonvolatile optical devices, such as tunable spectral filters and metalenses, using low-loss, electrically-tunable PCMs such as GeSbTe and GeSbSeTe
2. Integrating said optical devices with heater electrodes and control electronics for actively-tunable operation
3. Testing these devices in relevant environments, and transitioning the technology to end-users

Tasks associated with these efforts include a mixture of experimental and theoretical approaches, including: optical device design, modeling, and simulation (e.g., thin-film multilayer stacks, plasmonic devices, and dielectric metasurfaces); cleanroom-based device fabrication (i.e. thin-film deposition, lithography, etching, etc.); PCM film characterization / metrology; integration of PCM metasurfaces with electrical heaters, and; characterization of the fabricated devices.

Minimum Job Requirements: We are looking for researchers with

1. Extensive experience with metasurface optics design/modeling, integrated photonics, and optic device testing.
2. Strong background in optical physics or engineering, optical materials / devices, spectroscopy / remote sensing.
3. Experience with cleanroom-based device fabrication.

Desired Qualifications:

1. Knowledge and background of chalcogenide phase change materials (PCMs) and/or ultrafast tuning metasurface optics
2. Experience in data collection /analysis /modeling of imaging spectroscopy using MATLAB or an equivalent program.

Education / Experience: A Ph.D. in a relevant field completed within the past 5 years or soon to be completed.

[Research Background]

Imaging spectroscopy (IS) is at the heart of a plethora of NASA Earth and Space Science missions; optical filters are critical components



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underpinning these missions. Each mission typically places a set of uniquely different, yet stringent performance requirements on these components, and unfortunately existing technologies fall short. NASA has been developing a state-of-the-art actively tunable optical filter platform based on chalcogenide PCMs [1,2]. These non-volatile materials exhibit unique electro-optic behavior, and through nanostructured (metasurface) or thin-film multilayer architectures, can be utilized as novel tunable filters with excellent optical performance characteristics. This project directly supports NASA strategic goals/missions, including: (i) stratospheric aerosol and gas profiling in the visible and shortwave IR for SAGE [3], and (ii) real-time multiband thermal imaging in the midwave-IR. The project is focused on the development of an unrivalled, all-solid-state, actively-tunable optical filter technology platform that enables ultrafast switching, wide spectral tunability (near-IR to midwave-IR) and narrowband performance, all in a single, compact form factor.

[Project Team]

The successful candidate will be a part of the Advanced Measurements and Data Systems Branch (D304) of the Research Directorate and Chemistry and Dynamics Branch (E303) of the Science Directorate at NASA Langley Research Center, in Hampton VA. The candidate will coordinate with a multidisciplinary team of researchers (Research Directorate, Science Directorate, academia, and industry partner) in various aspects of the design, fabrication, testing, characterization, and analysis of optical devices / systems. In addition, the research will be mainly conducted in AMDSB optics labs and the ISO5 optical cleanroom. The researcher will also have the opportunity to participate in a number of ongoing and future projects, including studies of potential SmallSat-based spectroscopy configurations for global and accurate gas and aerosol properties.

[References]

- [1] C. Williams et al., "Tunable mid-wave infrared Fabry-Perot bandpass filters using phase-change GeSbTe", *Optic Express*, 28 (7), 10583 (2020);
- [2] M. Julian et al., "Reversible optical tuning of GeSbTe phase-change metasurface spectral filters for mid-wave infrared imaging", *Optica*, (2020);
- [3] NASA SAGE (Stratospheric Aerosol and Gas Experiment) project

Location:

Langley Research Center
Hampton, Virginia

Field of Science: Technology Development

Advisors:

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