Announcement:

CASIS releases request for proposals titled

Materials Testing in the Extreme Environment of Space

Request for Proposals

Center for the Advancement of Science in Space

Space Life Sciences Laboratory 505

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Exploration Park, FL 32953

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Letters of Intent Due: November 20, 2012

Proposal Due: December 27, 2012

The Center for the Advancement of Science in Space (CASIS) is an IRS section 501(c)(3) entity organized under the nonprofit laws of the state of Florida. CASIS seeks to advance scientific research and education in conjunction with the International Space Station (ISS) U.S. National Laboratory, managing a diverse research and education portfolio across a broad range of scientific fields.

The request for proposals (RFP) described in this document seeks to identify materials science projects, which CASIS will support through grant funding, facilitation of service-provider interactions, and flight coordination to and from the space station.

Contents

Target Audience and Project Information 3
Background 3
Research Objectives 3
Qualifications of Grantee 4
Required Deliverables 4
Progress Reports 5
Deadline for Completion of Project 5
Services and Support Provided by CASIS 6
Preflight, In Flight, and Postflight Services 6
Available Hardware and Facilities 7
Funding Available 7
Letters of Intent 8
Proposal Questions and Required Format 8
Section I: Background and Overview 8
Section II: Detailed Project Plan 8
Section III: Economic Impact of Project Success 10
Section IV: Budget and Time Frame 10
Section V: Additional Information 10
Section VI: Biographical Sketch 11
Contact Information 11

Target Audience and Project Information

This RFP is directed at providing support for space station utilization by commercial and academic investigators in the field of materials science. Responsive applications will describe using the extreme conditions of space for development and testing of new materials, components and systems that will have Earth-based applications. The NanoRacks External Platform provides a platform that can host a standardized CubeSat form factor for exploiting the extreme conditions of space accessible via ISS. It provides a platform with high data rates, payload return, human payload interface, and no extravehicular activity required. CASIS seeks proposals for devices and trays that are compatible with this platform for materials science initiatives.

Background

The extreme conditions of the space environment are demonstrably hostile to many materials. The space station's National Lab supports a variety of platforms to exploit this environment for the development and testing of new materials, devices, and subsystems. The newest hardware addition to the station is the NanoRacks External Platform, which provides a 10 cm x 10 cm x 10 cm "NanoLab" that plugs into the space station power and communications system.

Many specific conditions are made accessible by the space station's position in low Earth orbit:

- Atomic oxygen, the most prevalent atomic species encountered in low earth orbit, is highly reactive with plastics and some metals, causing severe erosion.
- Outside the Earth's atmospheric filter, extreme ultraviolet radiation deteriorates and darkens many plastics and coatings.
- The vacuum of the space environment alters the physical properties of many materials.
- Impact of meteoroids and orbiting man-made debris can damage materials exposed in space.

On Earth, it may be possible to subject a material to one of these conditions at a time, but the combined effects of these conditions can be investigated only in space. Moreover, while Earth-based experiments are often conducted under artificial conditions to provide simulated extreme operational conditions, space is the ultimate test condition—simultaneous exposure to multiple environmental extremes—providing a mechanism for rapid failure mode analysis.

Previous materials studies, such as The Materials International Space Station Experiment (MISSE), have evaluated a variety of materials, including components such as switches, sensors and mirrors as well as materials such as polymers, coatings and composites. For example, MISSE-7 carried a SpaceCube experiment that tested radiation-hardened, reconfigurable processors and microelectronics.

Research Objectives

Proposals should seek to exploit the space environment for testing of materials and devices. It is expected that applications will utilize the NanoRacks External Platform for development or testing of advanced sensors, electronics or materials that have commercial applications on Earth.

Proposed projects may include:

- Passive Materials Exposure: Experiments in which samples are mounted on the outside of the NanoLab and are thus passively exposed to the space environment.

- Active Materials Exposure: Experiments in which on-orbit sensors are used to collect data that is transmitted back to Earth.

Proposals focused on testing an existing device or material should describe the device/material and include information from ground-based studies. Proposals should explain the new experimental outcomes that may result from using the space environment, including potential influence on commercial applications.

CASIS strongly recommends submitting letters of support to demonstrate feasibility or commercial interest, when applicable.

CASIS will facilitate grantees in translating ground-based experiments into space-appropriate models. However, each proposer should be familiar with hardware capabilities of the NanoRacks External Platform for on-orbit studies. Details regarding this and other flight-certified hardware are available on the CASIS Web site (http://www.iss-casis.org/solicitations) and will be updated regularly. An ideal proposal will demonstrate investigator knowledge of the significant challenges and importance of translating ground-based experimental or testing methods into methods compatible with flight hardware**. All proposers should read this online material and the hardware section below under "Services and Support Provided by CASIS"** to clearly understand the hardware platform and capabilities on the station.

Qualifications of Grantee

Any U.S. institution that can respond to the target area described in this RFP may apply. However, CASIS will not consider projects using non-U.S. sponsorship.

The CASIS Operations team will conduct a technical review to ensure that the proposed project can meet the requirements for delivery to and research on the space station. The general requirements for flight are as follows:

- Overall readiness of materials and hardware
- Compatibility of proposed hardware with the NanoRacks platform
- Scientific justification for using the space station
- Ability to comply with NASA flight certification requirements

NASA has specified details regarding flight certification requirements, available on the Web at http://www.iss-casis.org/solicitations. The Operations team may reject proposals that cannot meet these requirements.

Before submitting proposals, new-to-space proposers must consult with the CASIS Operations team (operations@iss-casis.org) for feedback regarding feasibility and compliance with flight requirements and capabilities. The Operations team will be available for these consultations until November 20, 2012. CASIS also encourages proposers to contact NanoRacks, who will serve as the implementation partner for grantees, to discuss hardware capabilities and requirements. For more information about NanoRacks, including contact information, see the CASIS directory of implementation partners at http://www.iss-casis.org/solicitations.

Required Deliverables

Grantees will provide CASIS with operational reports on and findings from the research and development conducted using CASIS grant funding—subject to confidentiality agreements with grantees concerning research results.

Selected projects must be flight ready within 12 months of the award and must be completed (with final report submitted) within 24 months. If flight schedules change, investigators may modify proposed timelines, subject to review and approval by the CASIS Operations team.

Progress Reports

Grantees will submit progress reports at 3 months, 6 months and 9 months.

Many milestones and required preflight activities will take place in collaboration with NanoRacks—interactions that CASIS can facilitate. Whether grantees reach these milestones directly or in collaboration with NanoRacks, progress reports must document completion. Each report must include the following:

- An overview of grant expenditures and financial records, categorizing expenses using the same categories as employed in the proposal. Reports should note any anticipated future changes to the originally proposed budget.
- Status of each projected milestone in the proposal or grant agreement, including analysis of any unmet milestones. (For unmet milestones, grantees may have to meet with CASIS Operations staff to develop a plan to meet project objectives within the required timeline.)
- Identified resources for ground-based preflight and postflight activities. (Most, if not all, ground-based studies must be completed by the time of the second progress report to ensure flight readiness and, ultimately, that the necessary work and materials are ready for launch.)
- Results and relevant information from preflight activities, ground testing and on-orbit testing, including any changes in proposed experimental methodology or data analysis and processing.
- Development and testing status of required payload integration products, including elements to be flight certified (e.g., hardware, software, delivery timeline).
- When appropriate, status of development, testing and operation of hardware and products.
- Details confirming that flight research and development complies with NASA's space station payload requirements and all NASA rules and regulations of such activity.
- Information and data for consideration in the CASIS review process.

At the completion of the project, each grantee will submit a final report that addresses the following additional items:

- A listing of each objective in the original proposal.
- The extent to which the project achieved each objective and, for unmet objectives or expectations, an analysis of underlying issues and assumptions that may have influenced the unexpected outcome.
- A listing, from the investigator perspective, of each new finding that can be traced to methods or approaches developed in the funded work. The list should note any new outcomes related to microgravity or other flight-related variables.
- How the work benefits scientific advancement and/or commercial potential.
- The status of the project's influence on the greater U.S. population, as described in the initial proposal (i.e., scientific and economic impact). Discuss future directions for commercialization, if applicable, or for disseminating results, moving forward with the scientific or other relevant pathways.

Deadline for Completion of Project

Projects must be flight ready within 12 months of the award and must be completed (with final report submitted) within 24 months. If flight schedules change, investigators may modify proposed timelines, subject to review and approval by the CASIS Operations team.

Services and Support Provided by CASIS

In addition to providing access to the NanoRacks External Platform hardware, CASIS offers many support services to enable efficient execution of space-science initiatives, even for first-time users. In accordance with a cooperative agreement with NASA, CASIS will assist researchers and grantees in transitioning their science and research experiments into manifested payloads—including identifying and executing steps to meet the requirements discussed earlier in the "Deliverables" section.

Services include solicitation and coordination with NanoRacks, identification of and facilitation in acquiring required hardware and software, access to state-of-the-art laboratories, coordination of ground-based work, and coordination with NASA. CASIS will facilitate in these processes, specific support for implementation services will be noted in the written agreement between the grantee(s) and CASIS.

For funded projects, CASIS will provide access to on-orbit facilities, data processing capabilities and crew time, without charge, for experiments. NASA will supply transport and on-orbit resources within the available capacity and without additional cost. CASIS will provide integration and operations services, and engineering, safety, documentation and standard agreements aspects of conducting experiments on the space station. These costs will be covered by CASIS. The grantee will be responsible for all other costs, including but not limited to costs associated with ground-based preparatory studies and subsequent data analyses.

Preflight, In Flight, and Postflight Services

In addition to overall project management, CASIS will facilitate the following specific support services.

Before research on the space station begins, CASIS offers ground-based products and services for grantees. CASIS can facilitate:

- Access to a large repository of previous space experiments with promising commercial development and innovation
- Collaboration with experienced payload developers and other subject matter experts to ensure successful experiments and completion of all mission requirements; to provide payload integration support; and to coordinate with NASA in crew training, procedure development, and timeline activities planning
- Access to state-of-the-art laboratories at the Space Life Sciences Laboratory at Kennedy Space Center, offering specialized capabilities and facilities for developing payloads
- Coordination with NASA and launch vehicle providers to produce an integrated schedule

During flight, CASIS offers project management services and support for product development, including:

- Support of "real time" on-orbit payload operations
- Facilitation of data and software interfaces
- Coordination of contingency planning and mission changes to preserve science objectives

After completion of research on the station, CASIS may facilitate additional services:

- Identification of appropriate facilities for postprocessing activities
- Coordination with NanoRacks to ensure that all postflight data and report requirements are submitted to NASA and the principal investigator (PI) in a timely fashion
- Help in finding resources for intellectual property identification, registration and protection
- Help in finding resources for compliance with export control regulations
- Coordination of in situ experiment termination, including cold stowage, fixation and data analysis
- Coordination and collaboration with the PI to ensure overall project success

Available Hardware and Facilities

This solicitation will provide access to 2 x 2U NanoLab modules. Proposals should therefore describe studies that will utilize a 2U configuration. The NanoRacks External Platform will support devices and trays with the following features:

- Mass: 2 kg
- Dimensions: 20cm x 10cm x 10cm
- Power: 2W max (5VDC, 400mA)
- Data: USB 2.0
- NanoRacks will provide a cable with the appropriate connectors for power and data specified above
- Thermal: heat sink to platform at base

For samples mounted on the exterior of the NanoLab, samples can be mounted with direct and sheltered exposure (allowing for the collection of control data). After a six-month exposure to the space environment, samples will be brought back into the station and returned to Earth via the Soyuz or Dragon vehicles for analysis.

For experiments using on-orbit data collection sensors, data regarding specific material changes or characteristics are returned to Earth via the space station's data system. Examples of data collection sensors are:

- USB Cameras, which photograph sample coupons to observe material changes
- Microphones, which detect debris hits to samples or vibrations
- Photosensors, which detect material color changes or penetration
- Electrometers, which detect charge/discharge effects of materials
- Resonant sensors, which detect mass changes to materials

A microcontroller board inside the NanoLab controls these sensors and interfaces with the NanoRacks External Platform computer (via USB), which interfaces with the space station data system to transmit the data to Earth or to provide commands to the payload. These sensors for on-orbit material examination can also be used to augment data collected from materials returned to Earth via Soyuz or Dragon.

Proposers are strongly urged to thoroughly investigate the NanoRacks External Platform and contact CASIS or NanoRacks to ensure that specifications and requirements for devices and trays being contemplated for this hardware platform are well understood and appropriate for the proposed studies. Proposers may contact the CASIS Operations team (operations@iss-casis.org) to submit questions. The Operations team will be available through November 20, 2012, to receive these queries. Answers will appear on the CASIS Web site. However, CASIS will not post answers that would jeopardize intellectual property or proprietary information.

Funding Available

CASIS will award grant funding (up to $200,000 per proposal) to qualified proposals to cover the proposer's costs. The number of grants awarded and the amount of the grants will depend on the number of meritorious applications received.

Letters of Intent

All investigators who wish to submit a proposal for this RFP must submit a letter of intent to LOI@iss-casis.org no later than November 20, 2012.

The letter of intent (maximum one page) is not binding and will not be considered during the review of a subsequent proposal. The letter should include the following information, which CASIS requests to allow staff to estimate the potential review workload:

- Title of proposed research
- Brief description of the proposal
- Name, address and telephone number of the principal investigator
- Name, address and telephone number of the authorized institutional official
- Participating institution(s)

A Letter of Intent must be submitted in order to receive a copy of RFP No. 2012-2 that includes details on CASIS' Policies and Governance.

CASIS will accept electronic submission of proposals from December 5-27, 2012. Instructions will be available at http://www.iss-casis.org/solicitations. All proposals must be submitted by 5:00 p.m. EST, December 27, 2012.

Proposal Questions and Required Format

All information submitted in a proposal will be treated as confidential and will be reviewed by only CASIS and third parties providing assistance to CASIS in proposal review. Proposals must be single-spaced. Margins should be 0.75". Font size should be 11-point Arial, Calibri, Helvetica, Palatino Linotype or Georgia typeface, black type only. Do not include headers or footers. Avoid using columns in text. Proposals may include graphics, which must fit within the designated page limits and should be kept to a minimum.

Proposals may include a cover letter (maximum one page), which should briefly summarize the proposal: outline of project, scientific significance and potential commercial impact. Include any conflicts of interest and special situations (these should also be detailed in Section IV). Short bullet points are encouraged.

Section I: Background and Overview

Maximum two pages.

1. Abstract
2. Background, Significance, and Preliminary studies: Specifically note relevance to the CASIS mission and to RFP objectives. Include and explain background information from previous studies and preliminary data (e.g., syntheses, measurements or tests).

Section II: Detailed Project Plan

Maximum six pages.

1. Research Design and Methodology
    a. Research Questions (maximum one page): What are the main scientific questions that you plan to address? If appropriate, present as a hypothesis with specific aims. State concisely the goals of the proposed research and summarize the expected outcome(s), including how the proposed research will affect the research field(s) involved. List succinctly the specific objectives of the research proposed (e.g., to test a stated hypothesis, create a new design, solve a specific

problem, challenge an existing paradigm, address a critical barrier to progress in the field, or develop new technology).

b. Research Strategy: Outline the overall technical approach that you plan to use to address the above. Describe the proposed research, stating its significance and how it will be conducted. Cite published experimental details in the Research Strategy section, and supply the full reference in the Bibliography and References Cited section.
    i. Significance: Explain why the problem is important and how the project addresses any critical barriers to progress in the field. Explain how the proposed project will improve scientific knowledge, technical capability and/or commercialization efforts in one or more broad fields. Describe how achieving the proposed aims will change the concepts, methods, or technologies that drive this field.
    ii. Innovation: Explain how the application challenges and seeks to shift current research paradigms. Describe any new theoretical concepts, approaches or instrumentation to be developed or used, as well as any advantage over existing methods and instrumentation. Explain any improvements or new applications of theoretical concepts, approaches or instrumentation. Describe any potential to yield a new line of space research or to build upon prior space station research.
    iii. Approach: Describe the project's overall strategy, approach and analyses to accomplish specific aims. Include how the data will be collected, analyzed and interpreted. Discuss potential problems, alternative strategies and benchmarks for success anticipated to achieve the aims. If the project is in the early stages of development, describe strategies to establish feasibility, and address the management of any high-risk aspects of the proposed work.
        - Experimental conditions: Discuss the rationale for testing conditions, including details regarding proper statistical design and appropriate sample sizes, if relevant. Proposals testing a device or material should include information from preliminary ground-based studies.
        - Translation: Describe how the proposers intend to translate ground-based experimental methods and conditions to function within the available space-based hardware, taking into account hardware limitations and conditions. Note specific materials to be used to allow the Operations team to review space station protocols and requirements.
        - Ground-based experiments: Clearly delineate specific ground-based experiments that will be performed in preparation for flight and alongside flight experiments as controls. Specifically note the relevance and research plan for ground controls. Discuss comparisons with established ground experiments or space studies. Include enough data and experimental methods for reviewers to determine feasibility.

2. Technical Aspects of Spaceflight: If not delineated in the Research Strategy, describe specifically the research tasks and expected outcomes. Include any technical milestones that must be met for the research to be successful. Explain which research tasks will be carried out at the users' home institution or elsewhere outside of the NanoLab environment. Describe how the scientific environment and specifically the NanoRacks External Platform will enhance the probability of success of the project, unique features of the environment and the institutional investment in the success of the investigator (e.g., resources).

Section III: Economic Impact of Project Success

Maximum three pages (two pages for item 1, and one page for item 2).

1. Describe the project's potential commercial impact. Which market vertical(s) will it address (e.g., to which specific industries will it be relevant)? Describe further the scientific or commercial value of the research, development or testing of the targeted materials or devices. Is the research relevant to current commercial or industrial applications or would it create a new market? Describe the estimated size of (in dollars and in population, if applicable), growth of, and competition within (company, product, cost) the market vertical(s). For all proposals, be explicit about potential applications of successful project results, and note whether successful results will be published or disseminated. If relevant, explain how your project, if successful, might enter its relevant market(s)—and how the advances from your work would be superior to other products or would be unique in the market. Estimate the time to market, including necessary certification steps. Describe how you will measure progress toward potential commercial application. Describe funding received to date and estimated funding required to bring the product to market. List any potential opportunities for intellectual property, supporting these anticipated successes with potential comparable intellectual property.
2. Describe any other impact of your results relevant to economic evaluation, including humanitarian impact. For example, explain how successful results might promote teaching, training and learning or broaden participation of underrepresented groups in science or technology. Describe how successful results would affect quality of life in the U.S. Describe how the project might advance U.S. leadership in space.

Section IV: Budget and Time Frame

No page limit, but be succinct.

Provide a projected budget and time frame, broken down by month and organized using the following categories of cost, including personnel effort, supplies and ground experiments/controls:

- Salary and fringe benefits for personnel
- Equipment and supplies
- Consultant costs
- Alterations and renovations
- Publications and miscellaneous costs
- Contract services
- Consortium costs
- Travel expenses

Include justification for major cost elements. Include preflight development and testing considerations, time to flight, and time to completion. Include milestones for project feasibility, preparation and success.

Section V: Additional Information

No page limit, but be succinct.

1. Provide a signed Certificate Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion, using the form provided in Attachment B.
2. Provide a brief statement of the proposer's qualifications, including financial resources and organizational abilities to manage and complete the proposed project.
3. Provide letters of commercial support (should not exceed five pages).

4. Provide letters of commitment from collaborators. The proposal should contain a signed letter from each collaborator to the proposer that identifies the contribution the collaborator intends to make and a commitment to perform the work.
5. If another government or funding agency has reviewed the proposed project, proposers must provide the results and scoring details/comments of that review.
6. Provide a list of up to three references familiar with the proposer's qualifications and/or prior research experience.
7. Disclose all potential conflicts of interest.
8. Furnish a bibliography of any references cited. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers and year of publication.

Section VI: Biographical Sketch

Maximum three pages per biographical sketch.

Supply a biographical sketch for each proposer and background on key collaborators. Include information on past success in the field of study. Specifically describe the research team's experience and expertise relevant to this research project. In addition, please include 4 sections in the following sequence:

1. Educational History (in reverse chronology)
2. Professional Experience
3. Publications
4. Current Grant Funding

Contact Information

Submit questions regarding the RFP to info@iss-casis.org. Questions and answers will be posted on the CASIS Web site (http://www.iss-casis.org/solicitations). CASIS encourages prospective respondents to submit questions by November 9, 2012, to ensure that questions will be answered well before the submission date.