DEPARTMENT OF THE NAVY (DON)
23.1 Small Business Innovation Research (SBIR)
Direct to Phase II (DP2) Announcement and Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to Direct to Phase II (DP2) SBIR topics only:**
  - **N231-D01 through N231-D06**
- **The information provided in the DON Proposal Submission Instruction document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).**
- **Proposing small business concerns that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF) or any combination of these are eligible to submit proposals in response to DON topics advertised in this BAA. Information on Majority Ownership in Part and certification requirements at time of submission for these proposing small business concerns are detailed in the section titled ADDITIONAL SUBMISSION CONSIDERATIONS.**
- A DP2 Phase I Feasibility proposal template (for Volume 2), unique to DP2 topics, and a Supporting Documents template (Volume 5) are available at https://www.navysbir.com/links_forms.htm.
- DON provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.

INTRODUCTION

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON's Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information on DON's mission can be found on the DON website at www.navy.mil.

The Department of Defense (DoD), including the Department of the Navy (DON), may issue an SBIR award to a small business concern under Phase II , without regard to whether the small business concern received a Phase I award for such project. Prior to such an award, the head of the agency, or their designee, must issue a written determination that the small business concern has demonstrated the scientific and technical merit and feasibility of the technology solution that appears to have commercial potential (for use by the government or in the public sector). The determination must be submitted to the Small Business Administration (SBA) prior to issuing the Phase II award. As such, DON issues this portion of the BAA in accordance with the requirements of the Direct to Phase II (DP2) authority. Only those proposing small business concerns that are capable of meeting the DP2 proposal requirements may participate in this DP2 BAA. No Phase I awards will be issued to the designated DP2 topic.

Digital Engineering. DON desires the ability to design, integrate, and test naval products by using authoritative sources of system data, which enables the creation of virtual or digital models for learning and experimentation, to fully integrate and test actual systems or components of systems across disciplines to

support lifecycle activities from concept through disposal. To achieve this, digital engineering innovations will be sought in topics with titles leading with DIGITAL ENGINEERING.

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	**When**	**Contact Information**
Program and administrative	Always	Program Managers list in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA for details.
Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DSIP Support via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	Navy SBIR/STTR Program Management Office usn.pentagon.cnr-arlington-va.mbx.navy-sbir-sttr@us.navy.mil

TABLE 2: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

Topic Numbers	Point of Contact	SYSCOM	Email
N231-D01	Ms. Kristi Wiegman	Naval Air Systems Command (NAVAIR)	navair.sbir@navy.mil
N231-D02 to N231-D06	Mr. Michael Pyryt	Strategic Systems Programs (SSP)	ssp.sbir@ssp.navy.mil

Each DON SBIR DP2 topic requires documentation to determine that Phase I feasibility, described in the Phase I section of the topic, has been met.

The DON SBIR DP2 is a two-step process:

STEP ONE: Prepare and Submit a Phase I Feasibility Proposal (instructions and link to template provided below). The purpose of the Phase I Feasibility Proposal is for the proposing small business concern to provide documentation to substantiate that both Phase I feasibility and the scientific and technical merit described in the topic have been met. The Phase I Feasibility Proposal must: demonstrate that the proposing small business concern performed Phase I-type research and development (R&D) and provide a concise summary of Phase II objectives, work plan, related research, key personnel, transition/commercialization plan, and estimated costs. Feasibility

documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work. The government will evaluate Phase I Feasibility Proposals and select small business concerns to submit a Full DP2 Proposal. Demonstrating proof of feasibility is a requirement for a DP2 award. The small business concern must submit a Phase I Feasibility Proposal to be considered for selection to submit a Full DP2 Proposal.

STEP TWO: If selected, the cognizant SYSCOM Program Office will contact the small business concern directly to provide instructions on how to submit a Full DP2 Proposal.

DON SBIR reserves the right to make no awards under this DP2 BAA. All awards are subject to availability of funds and successful negotiations. Proposing small business concerns must read the topic requirements carefully. The Government is not responsible for expenditures by the proposing small business concern prior to award of a contract. For 23.1 topics designated as DP2, DON will accept only Phase I Feasibility Proposals (described below).

DP2 PROPOSAL SUBMISSION REQUIREMENTS

The following section details requirements for submitting a compliant DON SBIR DP2 Proposal to the DoD SBIR/STTR Programs.

(NOTE: Proposing small business concerns are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.)

DoD SBIR/STTR Innovation Portal (DSIP). Proposing small business concerns are required to submit proposals via the DoD SBIR/STTR Innovation Portal (DSIP); follow proposal submission instructions in the DoD SBIR/STTR Program BAA on the DSIP at https://www.dodsbirsttr.mil/submissions. Proposals submitted by any other means will be disregarded. Proposing small business concerns submitting through DSIP for the first time will be asked to register. It is recommended that proposing small business concerns register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process. Proposals that are not successfully certified electronically in DSIP by the Corporate Official prior to BAA Close will NOT be considered submitted and will not be evaluated by DON. Please refer to the DoD SBIR/STTR Program BAA for further information.

Eligibility. Each proposing small business concern must:

- Have demonstrated feasibility of Phase I-type R&D work
- Have submitted a Phase I Feasibility Proposal for evaluation
- Meet Offeror Eligibility and Performance Requirements as defined in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA
- Comply with primary employment requirements of the principal investigator (PI) during the Phase II award including, employment with the small business concern at the time of award and during the conduct of the proposed project. Primary employment means that more than one-half of the PI's time is spent in the employ of the small business concern
    - Register in the System for Award Management (SAM) as defined in the Proposal Fundamentals section of the DoD SBIR/STTR Program BAA. To register, visit https://sam.gov/

Proposal Volumes. The following six volumes are required.

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR Program BAA.

- **Technical Volume (Volume 2).**
  - Technical Proposal (Volume 2) must meet the following requirements or the proposal will be REJECTED:
    - Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
    - Single column format, single-spaced typed lines
    - Standard 8 ½" x 11" paper
    - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
    - No font size smaller than 10-point

  - Additional information:
    - It is highly recommended that proposing small business concerns use the DP2 Phase I Feasibility proposal template at https://navysbir.com/links_forms.htm to meet DP2 Technical Volume (Volume 2) requirements.
    - A font size smaller than 10-point is allowable for headers, footers, imbedded tables, figures, images, or graphics that include text. However, proposing small business concerns are cautioned that if the text is too small to be legible it will not be evaluated.

- **Cost Volume (Volume 3).** The text fields related to costs for the proposed effort must be answered in the Cost Volume of the DoD Submission system (at https://www.dodsbirsttr.mil/submissions/), however, proposing small business concerns DO NOT need to download and complete the separate cost volume template when submitting the DON SBIR Phase I Feasibility Proposal. Proposing small business concerns are to include a cost estimate in the Order of Magnitude Cost Estimate Table (example below) within the Technical Volume (Volume 2). Please refer to Table 3 below for guidance on cost and period of performance. Costs for the Base and Option are to be separate and identified on the Proposal Cover Sheet and in the Order of Magnitude Cost Estimate Table in the Technical Volume (Volume 2).

Order of Magnitude Cost Estimate Table			
Line Item – Details	**Estimated Base Amount**	**Estimated Option Amount**	**Total Estimated Amount Base + Option**
Direct Labor (fully burdened) – Prime			
Subcontractors/Consultants			
Material			
Travel & ODC			
G&A			
FCCM			
Fee/Profit			
TABA (NTE $25K, included in total amount)			
Total Estimated Costs			

TABLE 3: COST & PERIOD OF PERFORMANCE

Topic Number	Base		Option One		Total (NTE)
	Cost (NTE)	POP (NTE)	Cost (NTE)	POP (NTE)	
N231-D01	$1,000,000	24 mos.	$300,000	12 mos.	$1,300,000
N231-D02 to N231-D06	$900,000	18 mos.	$300,000	6 mos.	$1,200,000

- Additional information:

  For Phase II a minimum of 50% of the work is performed by the proposing small business concern. The percentage of work is measured by both direct and indirect costs. To calculate the minimum percentage of work for the proposing small business concern the sum of all direct and indirect costs attributable to the proposing small business concern represent the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) is the denominator. The subcontractor percentage is calculated by taking the sum of all costs attributable to the subcontractor as the numerator and the total cost of the proposal (i.e., Total Cost before Profit Rate is applied) as the denominator. **NOTE:** G&A, if proposed, will only be attributed to the proposing small business concern.

  — Provide sufficient detail for subcontractor, material, and travel costs. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel.

  — Inclusion of cost estimates for travel to the sponsoring SYSCOM's facility for one day of meetings is recommended for all proposals.

  — The "Additional Cost Information" of Supporting Documents (Volume 5) may be used to provide supporting cost details for Volume 3.

- **Company Commercialization Report (Volume 4)**. DoD collects and uses Volume 4 and DSIP requires Volume 4 for proposal submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Volume 5 is for the submission of administrative material that DON may or will require to process a proposal, if selected, for contract award.

  All proposing small business concerns must review and submit the following items, as applicable:

  — **Telecommunications Equipment Certification.** Required for all proposing small business concerns. The DoD must comply with Section 889(a)(1)(B) of the FY2019 National Defense Authorization Act (NDAA) and is working to reduce or eliminate contracts, or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As such, all proposing small business concerns must include as a part of their submission a written certification in response to the clauses (DFAR clauses 252.204-7016, 252.204-7018, and subpart 204.21). The written certification can be found in Attachment 1 of the DoD SBIR/STTR Program BAA. This certification must be signed by the authorized company representative and is to be uploaded as a separate PDF file in Volume 5. Failure to submit the required certification as a part of the proposal submission process will be cause for rejection of the proposal submission without evaluation. Please refer to

the instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.

- **Disclosure of Offeror's Ownership or Control by a Foreign Government.** All proposing small business concerns must review to determine applicability. In accordance with DFARS provision 252.209-7002, a proposing small business concern is required to disclose any interest a foreign government has in the proposing small business concern when that interest constitutes control by foreign government. All proposing small business concerns must review the Foreign Ownership or Control Disclosure information to determine applicability. If applicable, an authorized representative of the proposing small business concern must complete the Disclosure of Offeror's Ownership or Control by a Foreign Government (found in Attachment 2 of the DoD SBIR/STTR Program BAA) and upload as a separate PDF file in Volume 5. Please refer to instructions provided in the Phase I Proposal section of the DoD SBIR/STTR Program BAA.
- **Majority Ownership in Part.** Proposing small business concerns which are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DON topics advertised within this BAA. Complete certification as detailed under ADDITIONAL SUBMISSION CONSIDERATIONS.

- Additional information:
  - Proposing small business concerns may include the following administrative materials in Supporting Documents (Volume 5); a template is available at https://navysbir.com/links_forms.htm to provide guidance on optional material the proposing small business concern may want to include in Volume 5:
    - Additional Cost Information to support the Cost Volume (Volume 3)
    - SBIR/STTR Funding Agreement Certification
    - Data Rights Assertion
    - Allocation of Rights between Prime and Subcontractor
    - Disclosure of Information (DFARS 252.204-7000)
    - Prior, Current, or Pending Support of Similar Proposals or Awards
    - Foreign Citizens
  - Do not include documents or information to substantiate the Technical Volume (Volume 2) (e.g., resumes, test data, technical reports, or publications). Such documents or information will not be considered.
  - A font size smaller than 10-point is allowable for documents in Volume 5; however, proposing small business concerns are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6)**. DoD requires Volume 6 for submission. Please refer to the Phase I Proposal section of the DoD SBIR/STTR Program BAA for details.

DP2 EVALUATION AND SELECTION

The following section details how the DON SBIR/STTR Programs will evaluate Phase I Feasibility proposals.

Proposals meeting DSIP submission requirements will be forwarded to the DON SBIR/STTR Programs. Prior to evaluation, all proposals will undergo a compliance review to verify compliance with DoD and

DON SBIR/STTR proposal eligibility requirements. Proposals not meeting submission requirements will be REJECTED and not evaluated.

- **Proposal Cover Sheet (Volume 1).** The Proposal Cover Sheet (Volume 1) will undergo a compliance review to verify the proposing small business concern has met eligibility requirements and followed the instructions for Proposal Cover Sheet as specified in the DoD SBIR/STTR Program BAA.

- **Technical Volume (Volume 2).** The DON will evaluate and select Phase I Feasibility proposals using the evaluation criteria specified in the Phase I Proposal Evaluation Criteria section of the DoD SBIR/STTR Program BAA, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. The information considered for this decision will come from Volume 2. This is not a FAR Part 15 evaluation and proposals will not be compared to one another. Cost is not an evaluation criteria and will not be considered during the evaluation process; the DON will only do a compliance review of Volume 3. Due to limited funding, the DON reserves the right to limit the number of awards under any topic.

  The Technical Volume (Volume 2) will undergo a compliance review (prior to evaluation) to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
  - Not to exceed 30 pages, regardless of page content; Phase I Proof of Feasibility portion not to exceed 20 pages, Snapshot of Proposed Phase II Effort portion not to exceed 10 pages
  - Single column format, single-spaced typed lines
  - Standard 8 ½" x 11" paper
  - Page margins one inch on all sides. A header and footer may be included in the one-inch margin.
  - No font size smaller than 10-point, except as permitted in the instructions above.

- **Cost Volume (Volume 3).** The Cost Volume (Volume 3) will not be considered in the selection process and will undergo a compliance review to verify the proposing small business concern has met the following requirements or the proposal will be REJECTED:
  - Must not exceed values for the Base and Option (refer to Table 3).
  - Must meet minimum percentage of work; a minimum of 50% of the work is performed by the proposing small business concern.

- **Company Commercialization Report (Volume 4).** The CCR (Volume 4) will not be evaluated by the Navy nor will it be considered in the Navy's award decision. However, all proposing small business concerns must refer to the DoD SBIR/STTR Program BAA to ensure compliance with DSIP Volume 4 requirements.

- **Supporting Documents (Volume 5).** Supporting Documents (Volume 5) will not be considered in the selection process and will only undergo a compliance review to ensure the proposing small business concern has included items in accordance with the DP2 SUBMISSION INSTRUCTIONS section above.

- **Fraud, Waste, and Abuse Training Certificate (Volume 6).** Not evaluated.

ADDITIONAL SUBMISSION CONSIDERATIONS

This section details additional items for proposing small business concerns to consider during proposal preparation and submission process.

Discretionary Technical and Business Assistance (TABA). The SBIR and STTR Policy Directive section 9(b) allows the DON to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Proposing small business concerns may request, in their Cost Volume (Volume 3), to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase II TABA amount is up to $25,000 per award. The TABA amount, of up to $25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within the $1,800,000 or lower limit specified by the SYSCOM). The amount proposed for TABA cannot include any profit/fee by the proposing small business concern and must be inclusive of all applicable indirect costs. TABA cannot be used in the calculation of general and administrative expenses (G&A) for the SBIR proposing small business concern. A Phase II project may receive up to an additional $25,000 for TABA as part of one additional (sequential) Phase II award under the project for a total TABA award of up to $50,000 per project. A TABA Report, detailing the results and benefits of the service received, will be required annually by October 30.

Request for TABA funding will be reviewed by the DON SBIR/STTR Program Office.

If the TABA request does not include the following items the TABA request will be denied.

- TABA provider(s) (firm name)
- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform (to include the purpose and objective of the assistance)
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any profit or fee by the SBIR proposing small business concern
- Propose a TABA provider that is the SBIR proposing small business concern
- Propose a TABA provider that is an affiliate of the SBIR proposing small business concern
- Propose a TABA provider that is an investor of the SBIR proposing small business concern
- Propose a TABA provider that is a subcontractor or consultant of the requesting small business concern otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA requests must be included in the proposal as follows:

- Phase II:
  - DON Phase II Cost Volume (provided by the DON SYSCOM) - the value of the TABA request.
  - Supporting Documents (Volume 5) – a detailed request for TABA (as specified above) specifically identified as “TABA” in the section titled Additional Cost Information when using the DON Supporting Documents template.

Proposed values for TABA must NOT exceed:

- Phase II: A total of $25,000 per award, not to exceed $50,000 per Phase II project

If a proposing small business concern requests and is awarded TABA in a Phase II contract, the proposing small business concern will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other Phase II assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must participate in the virtual DON STP Kickoff during the first or second year of the Phase II contract. While there are no travel costs associated with this virtual event, Phase II awardees should budget time of up to a full day to participate. STP information can be obtained at: https://navystp.com. Phase II awardees will be contacted separately regarding this program.

Disclosure of Information (DFARS 252.204-7000). In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this award, the proposing small business concern shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons (defined by National Security Decision Directive 189). A small business concern whose proposed work will include fundamental research and requests to eliminate the requirement for prior approval of public disclosure of information must complete the DON Fundamental Research Disclosure and upload as a separate PDF file to the Supporting Documents (Volume 5) in DSIP as part of their proposal submission. The DON Fundamental Research Disclosure is available on https://navysbir.com/links_forms.htm and includes instructions on how to complete and upload the completed Disclosure. Simply identifying fundamental research in the Disclosure does **NOT** constitute acceptance of the exclusion. All exclusions will be reviewed and, if approved by the government Contracting Officer, noted in the contract.

Majority Ownership in Part. Proposing small business concerns that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, **are eligible** to submit proposals in response to DON topics advertised within this BAA.

For proposing small business concerns that are a member of this ownership class the following must be satisfied for proposals to be accepted and evaluated:

a. Prior to submitting a proposal, proposing small business concerns must register with the SBA Company Registry Database.
b. The proposing small business concern within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. A copy of the SBIR VC Certification can be found on https://navysbir.com/links_forms.htm. Include the SBIR VC Certification in the Supporting Documents (Volume 5).
c. Should a proposing small business concern become a member of this ownership class after submitting its proposal and prior to any receipt of a funding agreement, the proposing small business concern must immediately notify the Contracting Officer, register in the appropriate SBA database, and submit the required certification which can be found on https://navysbir.com/links_forms.htm.

System for Award Management (SAM). It is strongly encouraged that proposing small business concerns register in SAM, https:// sam.gov, by the Close date of this BAA, or verify their registrations are still active and will not expire within 60 days of BAA Close. Additionally, proposing small business concerns should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal.

Notice of NIST SP 800-171 Assessment Database Requirement. The purpose of the National Institute of Standards and Technology (NIST) Special Publication (SP) 800-171 is to protect Controlled Unclassified Information (CUI) in Nonfederal Systems and Organizations. As prescribed by DFARS 252.204-7019, in order to be considered for award, a small business concern is required to implement NIST SP 800-171 and shall have a current assessment uploaded to the Supplier Performance Risk System (SPRS) which provides storage and retrieval capabilities for this assessment. The platform Procurement Integrated Enterprise Environment (PIEE) will be used for secure login and verification to access SPRS. For brief instructions on NIST SP 800-171 assessment, SPRS, and PIEE please visit https://www.sprs.csd.disa.mil/nistsp.htm. For in-depth tutorials on these items please visit https://www.sprs.csd.disa.mil/webtrain.htm.

Human Subjects, Animal Testing, and Recombinant DNA. If the use of human, animal, and recombinant DNA is included under a DP2 proposal, please carefully review the requirements at: https://www.nre.navy.mil/work-with-us/how-to-apply/compliance-and-protections/research-protections. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

SELECTION, AWARD, AND POST-AWARD INFORMATION

Notifications. Email notifications for proposal receipt (approximately one week after the Phase I BAA Close) and selection are sent based on the information received on the proposal Cover Sheet (Volume 1). Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Debriefs. Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the proposal of the proposing small business concerns within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests. Interested parties have the right to protest in accordance with the procedures in FAR Subpart 33.1.

Pre-award agency protests related to the terms of the BAA must be served to: osd.ncr.ousd-r-e.mbx.SBIR-STTR-Protest@mail.mil. A copy of a pre-award Government Accountability Office (GAO) protest must also be filed with the aforementioned email address within one day of filing with the GAO.

Protests related to a selection or award decision should be filed with the appropriate Contracting Officer for an Agency Level Protest or with the GAO. Contracting Officer contact information for specific DON Topics may be obtained from the DON SYSCOM Program Managers listed in Table 2 above. For protests filed with the GAO, a copy of the protest must be submitted to the appropriate DON SYSCOM Program Manager and the appropriate Contracting Officer within one day of filing with the GAO.

Awards. Due to limited funding, the DON reserves the right to limit the number of awards under any topic. Any notification received from the DON that indicates the proposal has been selected does not ultimately guarantee an award will be made. This notification indicates that the proposal has been selected in accordance with the evaluation criteria and has been sent to the Contracting Officer to conduct cost analysis, confirm eligibility of the proposing small business concern, and to take other relevant steps necessary prior to making an award.

Contract Types. In addition to the negotiated contract award types listed in the section of the DoD SBIR/STTR Program BAA titled Proposal Fundamentals, for Phase II awards the DON may (under appropriate circumstances) propose the use of an Other Transaction Agreement (OTA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations. The DON may choose to use a Basic Ordering Agreement (BOA) for Phase I and Phase II awards.

Contract Deliverables. Contract deliverables are typically progress reports and final reports. Required contract deliverables must be uploaded to https://www.navysbirprogram.com/navydeliverables/.

Transfer Between SBIR and STTR Programs. Section 4(b)(1)(i) of the SBIR and STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa.

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description. Consequently, DON will assign SBIR/STTR Data Rights to any noncommercial technical data and noncommercial computer software delivered in Phase III that were developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

Navy SBIR 23.1 Direct to Phase II Topic Index

N231-D01 TITLE: DIRECT TO PHASE II - DIGITAL ENGINEERING - Improved Fiber Laser for Spectral Beam Combination

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Directed Energy (DE)

OBJECTIVE: Develop a robust, spectrally stabilized, continuous wave fiber-laser system with < 15 GHz spectral bandwidth that is free from stimulated Brillouin scattering and thermal mode instability at kW power levels.

DESCRIPTION: Fiber-laser sources are highly desired for high-energy laser (HEL) applications due to their compactness and robustness. The performance of high-power fiber lasers is hindered by two instabilities: stimulated Brillouin scattering (SBS) and thermal mode instability (TMI). SBS manifests as a reduction of output power coincident with a large backward propagating power that damages upstream components causing catastrophic failure. TMI manifests as significantly degraded beam quality, reducing power on target and HEL lethality.

Increasing HEL power requires combination of multiple beams through either spectral or coherent combination. Spectral beam combination (SBC) is viewed as the next step in fieldable laser weapons with significantly increased power levels and range. SBC requires that each source be a specific and separate wavelength with a sufficiently narrow bandwidth to allow dense spectral packing of sources and mitigate spectral beam dispersion. However, techniques to mitigate SBS and TMI instabilities for scaling to multi-kW powers from a single fiber-laser source element require broadened spectral linewidths that are far beyond SBC requirements.

New fiber-laser systems are required that can overcome these limitations. Most current solutions for mitigating SBS and TMI are extrinsic, requiring additional subsystems and controls that add complexity and increase the number of failure modes of the system. Intrinsic mitigation methods are fewer but tend not to lead to additional failure modes.

In addition to overcoming both SBS and TMI, the desired fiber laser should be able to cover the 40 nm bandwidth in the ytterbium doped fiber spectrum, with an individual channel spectral bandwidth of < 15 GHz and less than 1% of the power outside the spectral band. Center wavelength long-term stability should be less than 50 MHz. Output power should be > 1 kW with high beam quality of M2 < 1.3.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

- Provide a conceptual solution that is suitable for conventional spectral beam combining that can meet the stated requirements.
- Modeling and/or results of risk reduction experiments that validate the concept should be provided, along with a preliminary failure mode and effects analysis (FMEA).

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models,

and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 22.2 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Develop and optimize an innovative prototype fiber-laser system suitable for conventional spectral beam combining that can demonstrate the following requirements:

(a) high optical output power > 1 kW,
(b) good beam quality M2 < 1.3,
(c) narrow spectral bandwidth < 15 GHz,
(d) percentage of output power out of spectral band < 1%,
(e) center wavelength long-term stability < 50 MHz,
(f) complete mitigation of SBS,
(g) complete mitigation of TMI.

Characterize the system optical bandwidth, spectral stability, beam quality, and total pump power to signal power efficiency, all at maximum power level. Demonstrate ability to span the 40-nm wavelength range required for SBC. Validate the absence of SBS and TMI at maximum power level. Perform a preliminary failure mode and effects analysis (FMEA) for the proposed design. Project manufacturability of the system, highlighting COTS versus custom components and subsystems.

PHASE III DUAL USE APPLICATIONS: Provide demonstration of a full SBC laser system. Transition the technology to a major demonstration program such as an ONR-funded Future Naval Capability (FNC) or Innovative Naval Prototype.

Although the primary applications for the improved fiber laser would be for military laser systems, fiber lasers are routinely used in applications such as laser welding and cutting. There may be certain welding and cutting applications that may be improved with higher power fiber lasers that would result from the elimination of SBS and TMI in the fiber lasers.

REFERENCES:

1. Naderi, N. A., Dajani, I., & Flores, A. (2016). High-efficiency, kilowatt 1034 nm all-fiber amplifier operating at 11 pm linewidth. Optics letters, 41(5), 1018-1021. https://doi.org/10.1364/OL.41.001018
2. Brilliant, N. A. (2002). Stimulated Brillouin scattering in a dual-clad fiber amplifier. JOSA B, 19(11), 2551-2557. https://doi.org/10.1364/JOSAB.19.002551
3. Eidam, T., Wirth, C., Jauregui, C., Stutzki, F., Jansen, F., Otto, H. J., Schmidt, O., Schreiber, J. L., & Tünnermann, A. (2011). Experimental observations of the threshold-like onset of mode instabilities in high power fiber amplifiers. Optics express, 19(14), 13218-13224. https://doi.org/10.1364/OE.19.013218
4. Augst, S. J., Goyal, A. K., Aggarwal, R. L., Fan, T. Y., & Sanchez, A. (2003). Wavelength beam combining of ytterbium fiber lasers. Optics letters, 28(5), 331-333. https://doi.org/10.1364/OL.28.000331

KEYWORDS: optical fiber; fiber laser; high energy laser; spectral beam combination; directed energy

N231-D02 TITLE: DIRECT TO PHASE II – Novel, High Strength, High Temperature Silicon Carbide Fiber-reinforced Silicon Carbide (SiC/SiC) Ceramic Matrix Composite (CMC) Manufacturing Process for Hypersonic Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Space Technology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop an agile manufacturing process (including fiber production, preform development, interphase coating, matrix densification, and final machining) to produce high strength and high temperature randomly oriented short-fiber silicon carbide fiber-reinforced silicon carbide (SiC/SiC) ceramic matrix composites (CMCs).

DESCRIPTION: The Navy relies on CMCs for thermal protection systems (TPS), flight bodies, propulsion systems, and hypersonic applications. While carbon fiber-reinforced carbon (C/C) composites are the most commonly employed CMC, demand for increased speed and maneuverability requires high strength materials with the ability to survive at higher temperatures in oxidizing environments. One material of particular interest is silicon carbide fiber-reinforced silicon carbide (SiC/SiC). It is well suited to provide the mechanical strength, fracture toughness, and strength to weigh ratio needed for TPS applications, even when exposed to temperature in excess of 1500°C and highly corrosive environments. Production of these CMCs is often lengthy due the many steps involved in the manufacturing process, the fact that multiple vendors are often needed to complete these steps, and a limited supply chain. Additionally, some of the steps involved in the production of CMCs, such as the manufacturing of the fibers, are structured around a large process that requires significant overhaul to modify the material properties or produce new state-of-the-art materials. There is a need to develop a more agile CMC manufacturing process and supply chain that can produce CMCs and quickly adapt to ever-changing material demands.

This SBIR topic aims to develop a manufacturing process for discontinuous, short-fiber SiC/SiC CMCs. To reduce supply chain risks and lead times, this process (including fiber production, preform development, interphase coating, matrix densification, and final machining) should be able to be self-contained and provided by a single vendor to the furthest extent possible. The CMCs produced by this process should be composed of high purity constituents, as residual impurities or phases can result in reduced high temperature performance.

Work produced in Phase II may become classified. The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

- Designed a manufacturing process capable of producing randomly oriented short-fiber SiC/SiC CMCs.
- Determined the feasibility of the chosen manufacturing route.
- Demonstrated the capability to meet Phase II goals, including carrying out the manufacturing process, executing testing, and characterizing the final sample.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 23.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: The contractor is expected to complete the following Phase II:

- Design, develop, and demonstrate a manufacturing process capable of producing randomly oriented short-fiber SiC/SiC CMCs.
- Produce CMC samples for material characterization and testing in a high temperature and ablative environment.
- Ensure samples meet the needs communicated in the topic description. Document the process and materials.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: In Phase III the contractor is expected to finalize development, based on Phase II results, and aid in supplying the Navy with material needed to perform testing under representative flight conditions. The need for additional domestic sources of high temperature CMCs exists within other branches of the DoD, and potential uses for this technology exist in the commercial and aftermarket composite industry as well.

REFERENCES:

1. Katsumi Yoshida, Masamitsu Imai, Toyohiko Yano. Improvement of the mechanical properties of hot-pressed silicon-carbide-fiber-reinforced silicon carbide composites by polycarbosilane impregnation. Composites Science and Technology, Volume 61, Issue 9, 2001, Pages 1323-1329, ISSN 0266-3538.
2. Katsumi Yoshida. Development of silicon carbide fiber-reinforced silicon carbide matrix composites with high performance based on interfacial and microstructure control. Journal of the Ceramic Society of Japan, 2010, p. 82-90, 02/01/2010, Online ISSN 1348-6535, Print ISSN 1882-0743.

3. U. Papenburg, S. Walter, M. Selzer, S. Beyer, H. Laube, G. Langel, U. Papenburg, S. Walter, M. Selzer, S. Beyer, H. Laube and G. Langel. Advanced ceramic matrix composites (CMC's) for space propulsion systems. American Institue of Aeronautise and Astronautics, Inc. 33rd Joint Propulsion Conference and Exhibit, Seattle, WA, 06 July 1997 – 09 July 1997.
4. S. Schmidt, S. Beyer, H. Knabe, H. Immich, R. Meistring, A. Gessler. Advanced ceramic matrix composite materials for current and future propulsion technology applications. Acta Astronautica, Volume 55, Issues 3–9, 2004, Pages 409-420, ISSN 0094-5765.

KEYWORDS: Hypersonics; silicon carbide; ceramic matrix composites; manufacturing; fiber production; thermal protection system

N231-D03 TITLE: DIRECT TO PHASE II – Microstructural Analysis of Carbon-Carbon Structures for Hypersonic Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Space Technology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a microstructure model of both 2-D and 3-D carbon/carbon (C/C) examining the interface of matrix materials with various tow and yarn architectures.

DESCRIPTION: The Navy relies on ceramic matrix composites (CMCs) for thermal protection systems (TPS), flight bodies, propulsion systems, and hypersonic applications. Demand for increased speed and maneuverability requires high strength materials with the ability to survive at higher temperatures in oxidizing environments.

Carbon fiber-reinforced carbon (C/C) composites are the most commonly employed CMC. All or part of the aeroshell of a hypersonic vehicle consists of C/C material systems. These material systems are an anisotropic material comprised of several other bulk materials each of which has a unique architecture with fiber bundles (yarn) woven in specific fashion and converted to carbon-carbon. Predicting aeroshell performance in various specific situations is complex and generally involves using multiple toolsets anchored with empirical data.

In order to accurately model and support end-to-end analytical tools, the thermomechanical response of the aeroshell and full TPS over the course of the mission profile is necessary. It is this response which determines which mission profiles are viable. A thorough understanding permits engineering of the material better understanding of the design margins; and will enable design trades, analysis of performance boundary conditions, system lethality, and ultimately possible concept of operations (CONOPS). A thorough understanding also will permit modeling of the production process and will provide the insight necessary to make changes to the material system as the industrial base shifts, or as it is realized that small adjustments could improve performance or reduce cost.

Today, we know a lot about the material properties of a few of the architectures of 2-D and 3-D carbon-carbon from sample tests, hot ground tests, and flight tests. We know almost nothing about how the properties of the constituent materials affect the bulk material properties. Thus, we are at the mercy of "build and see" as opposed to having the tools at hand that might provide insights via modeling.

This SBIR topic aims to develop anchored models for 2-D and 3-D C/C material systems of interest at the peridynamic and meso scales. These models will then be used to inform higher level models and lead to constraints that can be applied in the optimization of trajectories tailored to a particular material type. The government will clarify the material systems of interest post award. The models may be incorporated into higher-level models at the meso scale and engineering model scale. Material characterization tests may be required in order to provide anchoring data for the models. If data exists on the material systems, access to those data may be provided upon contract award. Ultimately, a fast running analytical module will be developed which incorporates knowledge gained from the various multiscale analyses projects.

Performers may propose a modeling task, material characterization tasks or a combination. Modeling should indicate the scale of the proposed models and techniques planned.

Work produced in Phase II may become classified. The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

- Produced a concept for a model of composite systems.
- Described the objective use of the model and areas where peridynamic and/or meso scale information can be helpful in informing the model.
- Demonstrated knowledge of hypersonic thermal protection systems and knowledge of relevant material systems.
- Described ground tests that would be appropriate to anchor models at the various scales and recommend a test approach for peridynamic modeling, meso scale modeling, engineering model and fast running analytical code models.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 23.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: The performer is expected to complete the following during Phase II:

- Develop, mature and validate a material model to predict material performance based on constituent properties where the model is tailorable to mission profile requirements as outlined in the Description.
- Complete an analysis plan which incorporates capabilities and resolution of modeling gaps to accomplish objective.
- Develop thermal and structural material model framework which incorporates constituent information in formulation of anisotropic / orthotropic behavior.
- Plan, predict, collect, and incorporate experimental data in support of development of material models, to include performance and characterization information. The model shall be validated against experimental data. The model will be refined and re-validated with updated data/information.

• Parametric analysis results of constituent property changes of performance metrics shall be completed.
• Deliver all models, analysis, data, and results for government use.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Finalize development, based on Phase II results, and aid in supplying the Navy with detailed models needed to perform analysis sufficient to understand the impact of input materials, processing and flight conditions of a C/C material system under representative hypersonic flight conditions.

REFERENCES:

1. Xuewen Sun, Haibo Yang, Tao Mi, "Heat Transfer and Ablation Prediction of Carbon/Carbon Composites in a Hypersonic Environment Using Fluid-Thermal-Ablation Multiphysical Coupling", International Journal of Aerospace Engineering, vol. 2020, Article ID 9232684, 13 pages, 2020. https://doi.org/10.1155/2020/9232684
2. U. Papenburg, S. Walter, M. Selzer, S. Beyer, H. Laube, G. Langel, U. Papenburg, S. Walter, M. Selzer, S. Beyer, H. Laube and G. Langel. Advanced ceramic matrix composites (CMC's) for space propulsion systems. American Institue of Aeronautise and Astronautics, Inc. 33rd Joint Propulsion Conference and Exhibit, Seattle, WA, 06 July 1997 – 09 July 1997.
3. S. Schmidt, S. Beyer, H. Knabe, H. Immich, R. Meistring, A. Gessler. Advanced ceramic matrix composite materials for current and future propulsion technology applications. Acta Astronautica, Volume 55, Issues 3–9, 2004, Pages 409-420, ISSN 0094-5765.

KEYWORDS: Hypersonics; silicon carbide; 2-D Carbon Carbon; 3-D Carbon Carbon; manufacturing; peridynamic scales; meso scales; thermal protection system

N231-D04 TITLE: DIRECT TO PHASE II – Shaped, High Strength Silicon Carbide Fibers for Ceramic Matrix Composites (CMCs) in Hypersonic Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Space Technology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop a novel process for manufacturing shaped silicon carbide (SiC) fibers for advanced ceramic matrix composites (CMCs).

DESCRIPTION: Hypersonic vehicles and other strategic systems require advanced CMCs to protect them from ablative, oxidizing, and high temperature environments over long durations. The supply of these materials must be both domestic and stable to ensure they remain available to the warfighter. Currently, thermal protection system (TPS) materials have limited manufacturing capacity, are primarily carbon-carbon (C/C) based technology, take months to create, and have a higher than desired scrap rate (which leads to increased cost).

For next generation TPS, ultra-high temperature ceramics (UHTC), such as SiC, will supplant today's materials due to superior high temperature performance in oxidative operational environments. UHTCs have the potential to allow for optimized designs and improved vehicle performance currently not possible due to existing material constraints. It is essential that the U.S. has a domestic supply of advanced thermal protection materials as the DoD pursues hypersonic vehicle programs over the next decade.

While continuous fibers are employed as woven, braided, or knitted structures in many compositing applications, discontinuous fibers are being utilized in new and novel ways which provide various benefits. A primary benefit often includes rapid processing times. Short fibers mixed with a slurry or preceramic polymer have been used with injection molding, transfer molding, and inkjet writing. Discontinuous fibers can be used to construct yarns, tapes, or sheets that have improved drapability and formability. Additionally, control over the diameter and shape of the fiber cross section has the potential to improve the processability of short fibers and their performance.

This SBIR topic seeks the development of a novel production process for short SiC fibers. The process developed in this effort should: produce fiber with much greater temperature performance than existing fibers; be capable of producing multiple fiber compositions, such as UHTCs, with same underlying technology; be capable of adapting to produce various fiber morphologies and properties, including fibers with variably shaped profiles; be capable of large and small batch processes; be cost-effective and saleable; and produce minimal waste.

Work produced in Phase II may become classified. The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on

advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

- Developed the concept for a manufacturing process capable of producing short SiC fiber.
- Evaluated the manufacturing process, considering the desired process characteristics outlined in the topic description.
- Produced sample fiber via this manufacturing route and performed initial characterization and performance testing.
- Demonstrated the capability to meet Phase II goals, including developing the manufacturing process, executing testing, and characterizing the fibers.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 23.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: The contractor is expected to complete the following Phase II:

- Develop a manufacturing process capable of producing shaped, short SiC fiber in a timely and cost effective manner. Required process characteristics are outlined in the final paragraph of topic description.
- Understand how the processing conditions affect the fiber properties, and develop the process controls needed to govern fiber properties.
- Produce fiber and characterize it in terms of its microstructure (surface morphology, chemical composition, phase, and grain size), mechanical properties, and high-temperature capabilities.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: In Phase III the contractor is expected to finalize development, based on Phase II results, and aid in supplying the Navy with material needed to perform testing under representative flight conditions. The need for additional domestic sources of high temperature CMCs exists within other branches of the DoD, and potential uses for this technology exist in the commercial and aftermarket composite industry as well. Defense sector, space shuttles and any high-speed systems could utilize the developed cables and connectors.

REFERENCES:

1. U. Papenburg, S. Walter, M. Selzer, S. Beyer, H. Laube, G. Langel, U. Papenburg, S. Walter, M. Selzer, S. Beyer, H. Laube and G. Langel. Advanced ceramic matrix composites (CMC's) for space propulsion systems. American Institue of Aeronautise and Astronautics, Inc. 33rd Joint Propulsion Conference and Exhibit, Seattle, WA, 06 July 1997 – 09 July 1997.
2. S. Schmidt, S. Beyer, H. Knabe, H. Immich, R. Meistring, A. Gessler. Advanced ceramic matrix composite materials for current and future propulsion technology applications. Acta Astronautica, Volume 55, Issues 3–9, 2004, Pages 409-420, ISSN 0094-5765.

KEYWORDS: Hypersonics; silicon carbide; ceramic matrix composites; manufacturing; fibers; thermal protection system

N231-D05 TITLE: DIRECT TO PHASE II – Advanced System Performance Analysis of Carbon-Carbon Structures for Hypersonic Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Space Technology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Advance the state of the art in hypersonic flight performance modeling for carbon/carbon (C/C) architectures and assess vehicle performance as a function of the manufacturing process.

DESCRIPTION: The Navy relies on ceramic matrix composites (CMCs) for thermal protection systems (TPS), flight bodies, propulsion systems, and hypersonic applications. Demand for increased speed and maneuverability requires high strength materials with the ability to survive at higher temperatures in oxidizing environments. The extreme environments endured by the hypersonic TPS have an impact on flight performance, mission reliability, and cost. Legacy design tools treat C/C materials with bulk properties and empirical models that limit knowledge of how constituent properties of the material influence real-time flight performance. This technology gap drives conservative designs increasing cost, limits the flight envelope, and creates uncertainty in mission reliability from changes in material lot and vendor.

C/C composites are the most commonly employed CMC. All or part of the aeroshell of a hypersonic vehicle consists of C/C material systems. These material systems are an anisotropic material comprised of several other bulk materials each of which has a unique architecture with fiber bundles (yarn) woven in specific fashion and converted to carbon-carbon. Predicting aeroshell performance in various specific situations is complex and generally involves using multiple toolsets anchored with empirical data.
In order to accurately model and support end-to-end analytical tools, the thermomechanical response of the aeroshell and full TPS over the course of the mission profile is necessary. It is this response which determines which mission profiles are viable. A thorough understanding permits engineering of the material, better understanding of the design margins and will enable design trades, analysis of performance boundary conditions, system lethality, and ultimately possible concept of operations (CONOPS). A thorough understanding also will permit modeling of the production process and will provide the insight necessary to make changes to the material system as the industrial base shifts, or as it is realized that small adjustments could improve performance or reduce cost.

Today, we know a lot about the material properties of a few of the architectures of 2-D and 3-D carbon-carbon from sample tests, hot ground tests, and flight tests. We know almost nothing about how the properties of the constituent materials affect the bulk material properties. Thus, we are at the mercy of "build and see" as opposed to having the tools at hand that might provide insights via modeling.
Work produced in Phase II may become classified. The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified

information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

- The contractor is expected to have experience modifying and improving existing hypersonic software for the purpose of supporting aerothermal design, analysis, and prototyping.
- Demonstrated history in performing trade studies and models using modified codes for application to operations to assess hypersonic vehicle flight risk in flight tests and mission planning.
- Demonstrated processes will be improved under the Phase II for the benefit of hypersonics programs.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 23.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: This Direct to Phase II requires an assessment of the current capability in hypersonic flight performance analysis. The end result of the Phase II must clearly demonstrate how changes in C/C materials processing will impact flight performance in a way that is meaningful to materials engineers, system designers, flight analysts, and the warfighter. Minimum expectations during the Phase II include, but are not limited to:

- A system level process assessment to determine technology gaps in analysis code inputs
- Assessment of technology gaps in analysis outputs to support flight performance assessment
- A trade study design to demonstrate the impact of material design changes to flight performance
- Definition of applications of the technology to integrated production teams such as propulsion, lethality, and structures
- Software modifications for improved TPS material description and performance assessment
- Execution of the trade study and demonstration of the advantages of the technology
- Development of terms to support fast running analytical code development for various mission events
- Proposed test events necessary to anchor models
- Proposed path forward to extend the fast running analytical code to other material systems of interest.

It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: Finalize development, based on Phase II results, and aid in supplying the Navy with detailed models needed to perform analysis sufficient to understand the impact

of input materials, processing and flight conditions of a C/C material system under representative hypersonic flight conditions.

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KEYWORDS: Hypersonics; silicon carbide; 2-D Carbon Carbon; 3-D Carbon Carbon; manufacturing; peridynamic scales; meso scales; thermal protection system

N231-D06 TITLE: DIRECT TO PHASE II – Production of Silicon Boron Nitride (SiBN) Fibers for Ceramic Matric Composite (CMC) Radomes in Hypersonic Applications

OUSD (R&E) CRITICAL TECHNOLOGY AREA(S): Hypersonics; Space Technology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop advanced high temperature ceramic fibers exhibiting high strength, low dielectric constant, low loss tangent, high thermal stability, and high oxidation resistance for missile and projectile system applications.

DESCRIPTION: Missile components such as radomes and control surfaces are subjected to tremendous thermal stress during missile flight. Current missiles use high temperature metals for control surfaces and ceramics (such as silicon nitride or silica) for radomes. Future advanced missiles will require components with greater thermal shock resistance with properties such as those exhibited by ceramic matrix composites (CMCs). However, the only fibers available for incorporation into CMCs are fused silica ("quartz" fibers), Nextel aluminosilicate fibers from 3M, and Nicalon fibers. These fibers suffer from a limitation on service temperature, generally about 1000-1200°C for the oxide fibers, and 1400°C for silicon carbide fibers. In the past, there has been insufficient market potential to support commercial development of fibers for higher temperature service.

Higher temperature fibers are desired, with the capability of surviving 1500°C or higher. For radome applications, fibers with low dielectric constant and low loss tangent are needed. The desired values for dielectric properties, mechanical properties, and thermal properties depend on specifics of the radar system and overall weapon design, and can vary. There is no absolute limit for either, but the concepts are discussed in the reference by Walton [Ref 5]. Examples of possible compositions for high temperature, low-dielectric constant fibers include boron nitride (BN) and silicon nitride (Si_3N_4). Both types of fibers were produced experimentally in the 1975-1995 timeframe but are not available commercially. Availability of high temperature fibers possessing the desired combination of properties (such as high elastic modulus, low dielectric constant and loss tangent, and high strength to elevated temperatures) will enable the development of ceramic matrix composites with vastly improved high temperature properties compared to current CMCs.

Missile components needing these material technology improvements include radomes and control surfaces, since they tend to experience the worst of thermal heat stresses during high-speed flight. As such, the material solutions will need to have electrical properties conducive to radome functionality (e.g., low dielectric constant, low loss tangent) in addition to high thermal stability and high oxidation resistance necessary for both radomes and control surfaces.

Possible applications for the desired technology include tactical missiles, long range guided projectiles, and hypersonic vehicles.

Work produced in Phase II may become classified. The prospective contractor(s) must be U.S. owned and operated with no foreign influence as defined by DoD 5220.22-M, National Industrial Security Program

Operating Manual, unless acceptable mitigating procedures can and have been implemented and approved by the Defense Counterintelligence Security Agency (DCSA). The selected contractor must be able to acquire and maintain a secret level facility and Personnel Security Clearances, in order to perform on advanced phases of this project as set forth by DCSA and SSP in order to gain access to classified information pertaining to the national defense of the United States and its allies; this will be an inherent requirement. The selected company will be required to safeguard classified material IAW DoD 5220.22-M during the advanced phases of this contract.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort and developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

- Developed a concept for high temperature ceramic fiber materials that meets the parameters and applications in the Description.
- Established concept feasibility of the requirements through analysis, modeling, and experimentation of materials of interest.
- Demonstrated initial design specifications and capabilities as outlined in the description to build a prototype solution in Phase II.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic NOT solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 23.1 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: The contractor is expected to complete the following Phase II:

- Develop and deliver notional full-scale prototypes that demonstrate functionality under the required service conditions including thermal and mechanical stresses (parameters will be provided upon contract award).
- Use evaluation and testing to include high temperature mechanical tests, thermal shock tests, electrical tests, non-destructive testing, and microstructural examinations to show the prototype will meet Navy performance requirements (parameters will be provided upon contract award).
- Develop and propose a Phase III Development Plan to transition the technology to the Navy. It is probable that the work under this effort will be classified under Phase II (see Description section for details).

PHASE III DUAL USE APPLICATIONS: In Phase III the contractor is expected to finalize development, based on Phase II results, and aid in supplying the Navy with material needed to perform testing under representative flight conditions. The need for additional domestic sources of high temperature CMCs exists within other branches of the DoD, and potential uses for this technology exist in the commercial and aftermarket composite industry as well. Potential commercial uses for high-speed radome and control surface performance improvements exist in the commercial spacecraft and aircraft industries and satellite communications.

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2. Yokoyama, Yasuharu; Nanba, Tokuro; Yasui, Itaru; Kaya, Hiroshi; Maeshima, Tsugio and Isoda, Takeshi. “X-ray Diffraction Study of the Structure of Silicon Nitride Fiber Made from Perhydropolysilazane.” American Ceramic Society Journal, Volume 74, Issue 3, March 1991, pp. 654-657.
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KEYWORDS: Hypersonics; silicon boron nitride; fiber manufacturing; thermal shock; radomes; re-entry vehicles