

AIR FORCE
Small Business Innovation Research (SBIR) 10.1
Proposal Submission Instructions

The Air Force (AF) proposal submission instructions are intended to clarify the Department of Defense (DoD) instructions as they apply to AF requirements.

The Air Force Research Laboratory (AFRL), Wright-Patterson Air Force Base, Ohio, is responsible for the implementation and management of the AF Small Business Innovation Research (SBIR) Program.

The AF Program Manager is Mr. Augustine Vu, 1-800-222-0336. For general inquiries or problems with the electronic submission, contact the DoD Help Desk at 1-866-724-7457 (1-866-SBIRHLP) (8:00 am to 5:00 pm ET). For technical questions about the topics during the pre-solicitation period (12 November through 9 December 2009), contact the Topic Authors listed for each topic on the Web site. For information on obtaining answers to your technical questions during the formal solicitation period (10 December 2009 through 13 January 2010, go to <http://www.dodsbir.net/sitis/>. Please note that the SITIS system closes to receipt of new questions on September 9, 2009, but existing questions and answers in the system will remain available for viewing through the closing date of the solicitation.

For additional information regarding the SBIR/STTR Programs, a Defense Acquisition University (DAU) Continuous Learning Module, FA010, entitled “Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR)”, may be accessed (subject to availability) at <https://learn.dau.mil/html/clc/Clc1.jsp?cl>. It is recommended that those taking the course register as “General Public” and select “only browse the module not getting credit”. Site performance is enhanced by utilizing Internet Explorer. General information related to the AF Small Business Program can be found at the AF Small Business website, <http://www.airforcesmallbiz.org>. The site contains information related to contracting opportunities within the AF, as well as business information, and upcoming outreach/conference events. Other informative sites include those for the Small Business Administration (SBA), www.sba.gov, and the Procurement Technical Assistance Centers, www.aptac-us.org/new/Govt_Contracting/index.php. These centers provide Government contracting assistance and guidance to small businesses, generally at no cost.

The AF SBIR Program is a mission-oriented program that integrates the needs and requirements of the AF through R&D topics that have military and commercial potential.

PHASE I PROPOSAL SUBMISSION

Read the DoD program solicitation at www.dodsbir.net/solicitation for program requirements. When you prepare your proposal, keep in mind that Phase I should address the feasibility of a solution to the topic. For the AF, the contract period of performance for Phase I shall be nine (9) months, and the award shall not exceed \$100,000. We will accept only one Cost Proposal per Topic Proposal and it must address the entire nine-month contract period of performance.

The Phase I award winners must accomplish the majority of their primary research during the first six months of the contract. Each AF organization may request Phase II proposals prior to the

completion of the first six months of the contract based upon an evaluation of the contractor's technical progress and review by the AF technical point of contact utilizing the criteria in section 4.3 of the DoD solicitation. The last three months of the nine-month Phase I contract will provide project continuity for all Phase II award winners so no modification to the Phase I contract should be necessary. **Phase I technical proposals have a 20-page-limit (excluding the Cost Proposal, Cost Proposal Itemized Listing (a-h), and Company Commercialization Report).** The AF will evaluate and select Phase I proposals using review criteria based upon technical merit, principal investigator qualifications, and commercialization potential as discussed in this solicitation document.

ALL PROPOSAL SUBMISSIONS TO THE AF PROGRAM MUST BE SUBMITTED ELECTRONICALLY.

Limitations on Length of Proposal

The technical proposal must be no more than 20 pages (no type smaller than 10-point on standard 8-1/2" x 11" paper with one (1) inch margins). The Cost Proposal, Cost Proposal Itemized Listing (a-h), and Company Commercialization Report are excluded from the 20 page limit. Only the Proposal Cover Sheet (pages 1 and 2), the Technical Proposal (beginning with page 3), and any enclosures or attachments count toward the 20-page limit. In the interest of equity, pages in excess of the 20-page limitation (including attachments, appendices, or references, but excluding the Cost Proposal, Cost Proposal Itemized Listing (a-h), and Company Commercialization Report, will not be considered for review or award.

Phase I Proposal Format

Proposal Cover Sheets: Your Cover Sheets will count as the first two pages of your proposal no matter how they print out. If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released on the Internet; therefore, do not include proprietary information in these sections.

Technical Proposal: The Technical Proposal should include all graphics and attachments but should not include the Cover Sheet or Company Commercialization Report (as these items are completed separately). Most proposals will be printed out on black and white printers so make sure all graphics are distinguishable in black and white. It is strongly encouraged that you perform a virus check on each submission to avoid complications or delays in submitting your Technical Proposal. To verify that your proposal has been received, click on the "Check Upload" icon to view your proposal. Typically, your uploaded file will be virus checked and converted to a .pdf document within the hour. However, if your proposal does not appear after an hour, please contact the DoD Help Desk at 1-866-724-7457 (8:00 am to 5:00 pm ET).

Key Personnel: Identify in the Technical Proposal all key personnel who will be involved in this project; include information on directly related education, experience, and citizenship. A resume of the principle investigator, including a list of publications, if any, must be part of that information. Concise resumes for subcontractors and consultants, if any, are also useful. You must identify all U.S. permanent residents to be involved in the project as direct employees, subcontractors, or consultants. For these individuals, in addition to resumes, please provide

copies of the individuals' Green Cards. You must also identify all non-U.S. citizens expected to be involved in the project as direct employees, subcontractors, or consultants. For these individuals, in addition to resumes, please provide countries of origin, copies of visas, and explanation of the individuals' involvement.

Voluntary Protection Program (VPP): VPP promotes effective worksite-based safety and health. In the VPP, management, labor, and the Occupational Safety and Health Agency (OSHA) establish cooperative relationships at workplaces that have implemented a comprehensive safety and health management system. Approval into the VPP is OSHA's official recognition of the outstanding efforts of employers and employees who have achieved exemplary occupational safety and health. An "Applicable Contractor" under the VPP is defined as a construction or services contractor with employees working at least a 1,000 hours at the site in any calendar quarter within the last 12 months that is NOT directly supervised by the applicant (installation). The definition flows down to affected subcontractors. Applicable contractors will be required to submit Days Away, Restricted, and Transfer (DART) and Total Case Incident (TCIR) rates for the past three years as part of the proposal. Pages associated with this information will NOT contribute to the overall technical proposal page count.

Phase I Work Plan Outline

NOTE: PROPRIETARY INFORMATION SHALL NOT BE INCLUDED IN THE WORK PLAN OUTLINE. THE AF WILL USE THIS WORK PLAN OUTLINE AS THE INITIAL DRAFT OF THE PHASE I STATEMENT OF WORK (SOW).

At the beginning of your proposal work plan section, include an outline of the work plan in the following format:

- 1) Scope
List the major requirements and specifications of the effort.
- 2) Task Outline
Provide a brief outline of the work to be accomplished over the span of the Phase I effort.
- 3) Milestone Schedule
- 4) Deliverables
 - a. Kickoff meeting within 30 days of contract start
 - b. Progress reports
 - c. Technical review within 6 months
 - d. Final report with SF 298

Cost Proposal

Cost proposal information should be provided by completing the on-line Cost Proposal form and including the Cost Proposal Itemized Listing (a-h) specified below. The Cost Proposal information must be at a level of detail that would enable Air Force personnel to determine the purpose, necessity and reasonability of each cost element. Provide sufficient information (a-h

below) on how funds will be used if the contract is awarded. The on-line Cost Proposal, and Itemized Cost Proposal Information (a-h) will not count against the 20-page limit. The itemized listing may be placed in the “Explanatory Material” section of the on-line Cost Proposal form (if enough room), or as the last page(s) of the Technical Proposal Upload. (Note: Only one file can be uploaded to the DoD Submission Site). Ensure that this file includes your complete Technical Proposal and the Cost Proposal Itemized Listing (a-h) information.

a. Special Tooling and Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the government and relate directly to the specific effort. They may include such items as innovative instrumentation and/or automatic test equipment.

b. Direct Cost Materials: Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, and price and where appropriate, purposes.

c. Other Direct Costs: This category of costs includes specialized services such as machining or milling, special testing or analysis, costs incurred in obtaining temporary use of specialized equipment. Proposals, which include leased hardware, must provide an adequate lease vs. purchase justification or rationale.

d. Direct Labor: Identify key personnel by name if possible or by labor category if specific names are not available. The number of hours, labor overhead and/or fringe benefits and actual hourly rates for each individual are also necessary.

e. Travel: Travel costs must relate to the needs of the project. Break out travel cost by trip, with the number of travelers, airfare, per diem, lodging, etc. The number of trips required, as well as the destination and purpose of each trip should be reflected. Recommend budgeting at least one (1) trip to the Air Force location managing the contract.

f. Cost Sharing: Cost sharing is permitted. However, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal. Please note that cost share contracts do not allow fees.

g. Subcontracts: Involvement of university or other consultants in the planning and/or research stages of the project may be appropriate. If the offeror intends such involvement, describe in detail and include information in the cost proposal. The proposed total of all consultant fees, facility leases or usage fees, and other subcontract or purchase agreements may not exceed one-third of the total contract price or cost, unless otherwise approved in writing by the Contracting Officer.

(NOTE): The Small Business Administration has issued the following guidance:

“Agencies participating in the SBIR Program will not issue SBIR contracts to small business firms that include provisions for subcontracting any portion of that contract award back to the originating agency or any other Federal Government agency.” See Section 2.6 of the DoD program solicitation for more details.

Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed (i.e. Cost Proposal). At the very least, a Statement of Work (SOW) with a corresponding detailed cost proposal for each planned subcontract should be included.

h. Consultants: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required and hourly rate.

PHASE I PROPOSAL SUBMISSION CHECKLIST

Failure to meet any of the criteria will result in your proposal being **REJECTED** and the Air Force will not evaluate your proposal.

- 1) The Air Force Phase I proposal shall be a nine-month effort and the cost shall not exceed \$100,000.
- 2) The Air Force will accept only those proposals submitted electronically via the DoD SBIR Web site (www.dodsbir.net/submission).
- 3) You must submit your Company Commercialization Report electronically via the DoD SBIR Web site (www.dodsbir.net/submission).

It is mandatory that the complete proposal submission -- DoD Proposal Cover Sheet, Technical Proposal with any appendices, Cost Proposal, and the Company Commercialization Report -- be submitted electronically through the DoD SBIR Web site at <http://www.dodsbir.net/submission>. Each of these documents is to be submitted separately through the Web site. Your complete proposal **must** be submitted via the submissions site on or before the **6:00 am ET, 13 January 2010 deadline**. A hardcopy **will not** be accepted. Signatures are not required at proposal submission when submitting electronically. If you have any questions or problems with electronic submission, contact the DoD SBIR Help Desk at 1-866-724-7457 (8:00 am to 5:00 pm ET).

NOTE: If no exceptions are taken to an offeror's proposal, the Government may award a contract without discussions (except clarifications as described in FAR 15.306(a)). Therefore, the offeror's initial proposal should contain the offeror's best terms from a cost or price and technical standpoint. The Government reserves the right to conduct discussions if the Contracting Officer later determines them to be necessary.

The AF recommends that you complete your submission early, as computer traffic gets heavy near the solicitation closing and could slow down the system. **Do not wait until the last minute.** The AF will not be responsible for proposals being denied due to servers being "down" or inaccessible. Please assure that your e-mail address listed in your proposal is current and accurate. By the end of January, you will receive an e-mail serving as our acknowledgement that we have received your proposal. The AF is not responsible for notifying companies that change their mailing address, their e-mail address, or company official after proposal submission without proper notification to the AF.

AIR FORCE SBIR/STTR SITE

As a means of drawing greater attention to SBIR accomplishments, the AF has developed a SBIR/STTR site at <http://www.sbirsttrmall.com>. Along with being an information resource concerning SBIR policies and procedures, the SBIR/STTR site is designed to help facilitate the Phase III transition process. In this regard, the SBIR/STTR site: (a) SBIR Impact/Success Stories written by the Air Force; and (b) Phase I and Phase II summary reports that are written and submitted by SBIR companies. Since summary reports are intended for public viewing via the Internet, they should not contain classified, sensitive, or proprietary information. Submission of a Phase I Final Summary Report is a mandatory requirement for any company awarded a Phase I contract in response to this solicitation.

AIR FORCE PROPOSAL EVALUATIONS

Evaluation of the primary research effort and the proposal will be based on the scientific review criteria factors (i.e., technical merit, principal investigator (and team), and Commercialization Plan). Please note that where technical evaluations are essentially equal in merit, and as cost and/or price is a substantial factor, cost to the government will be considered in determining the successful offeror. The AF anticipates that pricing will be based on adequate price competition. The next tie-breaker on essentially equal proposals will be the inclusion of manufacturing technology considerations.

The AF will utilize the Phase I evaluation criteria in section 4.2 of the DoD solicitation in descending order of importance with technical merit being most important, followed by the qualifications of the principal investigator (and team), and followed by Commercialization Plan. The AF will use the Phase II evaluation criteria in section 4.3 of the DoD solicitation with technical merit being most important, followed by the Commercialization Plan, and then qualifications of the principal investigator (and team).

NOTICE: Only government personnel and technical personnel from Federally Funded Research and Development Center (FFRDC), Mitre Corporation and Aerospace Corporation, working under contract to provide technical support to Air Force product centers (Electronic Systems Center and Space and Missiles Center respectively) may evaluate proposals. All FFRDC employees at the product centers have non-disclosure requirements as part of their contracts with the centers. In addition, AF support contractors may be used to administratively process or monitor contract performance and testing. Contractors receiving awards where support contractors will be utilized for performance monitoring may be required to execute separate non-disclosure agreements with the support contractors.

On-Line Proposal Status and Debriefings

The AF has implemented on-line proposal status updates for small businesses submitting proposals against AF topics. At the close of the Phase I Solicitation – and following the submission of a Phase II via the DoD SBIR/STTR Submission Site (<https://www.dodsbir.net/submission>) – small business can track the progress of their proposal

submission by logging into the Small Business Area of the AF SBIR/STTR site (<http://www.sbirstrmall.com>). The Small Business Area (<http://www.sbirstrmall.com/Firm/login.aspx>) is password protected and firms can view their information only.

To receive a status update of a proposal submission, click the “Proposal Status” link at the top of the page in the Small Business Area (after logging in). A listing of proposal submissions to the AF within the last 12 months is displayed. Status update intervals are: Proposal Received, Evaluation Started, Evaluation Completed, Selection Started, and Selection Completed. A date will be displayed in the appropriate column indicating when this stage has been completed. If no date is present, the proposal submission has not completed this stage. Small businesses are encouraged to check this site often as it is updated in real-time and provide the most up-to-date information available for all proposal submissions. **Once the “Selection Completed” date is visible, it could still be a few weeks (or more) before you are contacted by the AF with a notification of selection or non-selection.** The AF receives thousands of proposals during each solicitation and the notification process requires specific steps to be completed prior to a Contracting Officer distributing this information to small business.

The Principal Investigator (PI) and Corporate Official (CO) indicated on the Proposal Cover Sheet will be notified by e-mail regarding proposal selection or non-selection. The email will include a link to a secure Internet page containing specific selection/non-selection information. Small Businesses will receive a notification for each proposal submitted. Please read each notification carefully and note the Proposal Number and Topic Number referenced.

In accordance with FAR 15.505, a pre-award debriefing may be received by written request. As is consistent with the DoD SBIR/STTR solicitation, the request must be received within 30 days after receipt of notification of non-selection. As found at FAR 15.505(a)(2), it may be requested that the debriefing be delayed until after award. Written requests for debriefing should be mailed to AFRL/XPP (SBIR), 1864 4th Street, Room 225, Wright-Patterson AFB OH, 45433-7130. Requests for debriefing should include the company name and the telephone number/email address for a specific point of contract, as well as an alternate. Also include the topic number under which the proposal(s) was submitted, the proposal number(s), and whether a pre- or post-award debrief(s) is desired. Debrief requests received more than 30 days after receipt of notification of non-selection will be fulfilled at the Contracting Officers' discretion. Unsuccessful offerors are entitled to no more than one debriefing for each proposal.

IMPORTANT: Proposals submitted to the AF are received and evaluated by different offices within the Air Force and handled on a Topic-by-Topic basis. Each office operates within their own schedule for proposal evaluation and selection. **Updates and notification timeframes will vary by office and Topic. If your company is contacted regarding a proposal submission, it is not necessary to contact the AF to inquire about additional submissions.** Check the Small Business Area of the AF SBIR/STTR site for a current update. Additional notifications regarding your other submissions will be forthcoming.

We anticipate having all the proposals evaluated and our Phase I contract decisions within approximately four months of proposal receipt. **All questions concerning the status of a proposal, or debriefing, should be directed to the local awarding organization SBIR Program Manager.** Organizations and their Topic Numbers are listed later in this section (before the Air Force Topic descriptions).

PHASE II PROPOSAL SUBMISSIONS

Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees that are **invited** to submit a Phase II proposal and all FAST TRACK applicants will be eligible to submit a Phase II proposal. Phase I awardees can verify selection for receipt of a Phase II invitation letter by logging into the “Small Business Area” at <http://sbirsttrmall.com>. If “Phase II Invitation Letter Sent” and associated date are visible, a Phase II invitation letter has been sent. If the letter is not received within 10 days of the date and/or the contact information for technical/contracting points of contact has changed since submission of the Phase I proposal, contact the appropriate AF SBIR Program Manager, as found in the Phase I selection notification letter, for resolution. Please note that it is solely the responsibility of the Phase I awardee to contact this individual. There will be no further attempts on the part of the AF to solicit a Phase II proposal. The awarding AF organization will send detailed Phase II proposal instructions to the appropriate small businesses. Phase II efforts are typically two (2) years in duration and do not exceed \$750,000. **NOTE: All Phase II awardees must have a Defense Contract Audit Agency (DCAA) approved accounting system. It is strongly urged that an approved accounting system be in place prior to the AF Phase II award timeframe. If you do not have a DCAA approved accounting system, this will delay / prevent Phase II contract award. If you have questions regarding this matter, please discuss with your Phase I Contracting Officer.**

All proposals must be submitted electronically at www.dodsbir.net/submission. The complete proposal – Department of Defense (DoD) Cover Sheet, entire Technical Proposal with appendices, Cost Proposal and the Company Commercialization Report – must be submitted by the date indicated in the invitation. The Technical Proposal is **limited to 50 pages** (unless a different number is specified in the invitation). The Commercialization Report, any advocacy letters, SBIR Environment Safety and Occupational Health (ESOH) Questionnaire, and Cost Proposal Itemized Listing (a-h) will not count against the 50 page limitation and should be placed as the last pages of the Technical Proposal file that is uploaded. (Note: Only one file can be uploaded to the DoD Submission Site. Ensure that this single file includes your complete Technical Proposal and the additional Cost Proposal information.) The preferred format for submission of proposals is Portable Document Format (.pdf). Graphics must be distinguishable in black and white. **Please virus-check your submissions.**

FAST TRACK

Detailed instructions on the AF Phase II program and notification of the opportunity to submit a FAST TRACK application will be forwarded with all AF Phase I selection e-mail notifications. The AF encourages businesses to consider a FAST TRACK application when they can attract outside funding and the technology is mature enough to be ready for application following successful completion of the Phase II contract.

NOTE:

- 1) Fast Track applications must be submitted not later than 150 days after the start of the Phase I contract.
- 2) Fast Track Phase II proposals must be submitted not later than 180 days after the start of the Phase I contract.
- 3) The AF does not provide interim funding for Fast Track applications. If selected for a Phase II award, we will match only the outside funding for Phase II.

For FAST TRACK applicants, should the outside funding not become available by the time designated by the awarding AF activity, the offeror will not be considered for any Phase II award. FAST TRACK applicants may submit a Phase II proposal prior to receiving a formal invitation letter. The AF will select Phase II winners based solely upon the merits of the proposal submitted, including FAST TRACK applicants.

AIR FORCE PHASE II ENHANCEMENT PROGRAM

On active Phase II awards, the AF will select a limited number of Phase II awardees for the Enhancement Program to address new unforeseen technology barriers that were discovered during the Phase II work. The selected enhancements will extend the existing Phase II contract award for up to one year and the AF will match dollar-for-dollar up to \$500,000 of non-SBIR government matching funds. Contact the local awarding organization SBIR Program Manager for more information. (See Air Force SBIR Organization Listing). If selected for a Phase II Enhancement, the company must submit a Phase II Enhancement application through the DoD Submission Web site at www.dodsbir.net/submission.

AIR FORCE SBIR PROGRAM MANAGEMENT IMPROVEMENTS

The AF reserves the right to modify the Phase II submission requirements. Should the requirements change, all Phase I awardees that are invited to submit Phase II proposals will be notified. The AF also reserves the right to change any administrative procedures at any time that will improve management of the AF SBIR Program.

PHASE I SUMMARY REPORTS

In addition to all the Phase I contractual deliverables, Phase I award winners must submit a Phase I Final Summary Report at the end of their Phase I project. The Phase I Summary Report is an unclassified, non-sensitive, and non-proprietary summation of Phase I results that is intended for public viewing on the AF SBIR/STTR site. A Summary Report should not exceed 700 words, and should include the technology description and anticipated applications/benefits for government and/or private sector use. It should require minimal work from the contractor because most of this information is required in the final technical report. The Phase I Summary Report shall be submitted in accordance with the format and instructions posted at <http://www.sbirsttrmall.com>.

AIR FORCE SUBMISSION OF FINAL REPORTS

All Final Reports will be submitted to the awarding AF organization in accordance with the Contract. Companies **will not** submit Final Reports directly to the Defense Technical Information Center (DTIC).

<p style="text-align: center;">SPECIAL INSTRUCTIONS for AF Manufacturing Topic AF101C-001 These special instructions apply only to topic AF101C-001, “Optical Grade Sapphire Manufacturing Growth Process for IR Window Applications”, and are in addition to the regular instructions listed at the beginning of the AF section of the solicitation.</p>

This is a Manufacturing related R&D SBIR topic. The primary focus of Phase I of this effort is the development of the technical, business and transition plans necessary to mature the manufacturing readiness of the proposed innovative sapphire window growth technology (to an MRL 7 by Phase II completion) and ensure its insertion into the manufacturing/inspection

processes of a DoD weapon system Production floor. It is anticipated that the technology readiness of the proposed solution will have already been demonstrated at TRL 5 or higher prior to Phase I. The focus of Phase II of this topic is the execution of the Phase I plans.

The AF plans on awarding multiple Phase I contracts on this topic. Each Phase I contract will be limited to \$100K. These Phase I contract awards will be normal nine (9) month efforts with six (6) months for the technical effort and an additional three (3) months for reporting. The AF plans on awarding one Phase II contract worth up to \$4.5M with a performance period of 24 months. Submission of Phase II proposals will be by invitation only. At that time, special instructions will be provided for the Phase II proposals.

A draft business plan will be a deliverable at the completion of Phase I along with the other final documentation. This draft Business Plan will be submitted for Phase II consideration as part of the Phase II proposal. It is anticipated that the AF Program Management IPT will work with Phase I award recipients to develop a viable plan for transitioning the technology to an AF customer at the end of Phase II. The business and transition plans will document the offeror's ability to address all aspects necessary to ensure implementation of the innovative approach to manufacturing upon completion of the Phase II award.

As this effort is focused on AF weapon system production, successful offerors may find it useful to dialog and/or partner with an AF/DoD prime in order to understand their specific system requirements, implementation risks and transition windows. Successful offerors may also benefit from consideration of technical as well as manufacturing and business readiness levels when preparing responses to Manufacturing SBIRs. Guidance and information on these three readiness measures can be found in the Air Force SBIR/STTR site located at <http://sbirsttrmall.com/Library/Default.aspx>. Identification of the return on investment (ROI) through a quantitative cost analysis should be addressed since this SBIR stresses the production implementation of developed technologies over existing baseline capabilities.

Air Force Program Manager Listing

Topic Number	Activity	Program Manager	Contracting Authority (for contract questions only)
AF101C-001	Materials & Mfg. Directorate AFRL/RX 2977 Hobson Way, Rm. 406 Wright-Patterson AFB, OH 45433	Debbie Shaw (937) 255-4839	Nick Voiles (937) 656-9092

Air Force SBIR 10.1 Topic Index

AF101C-001

Optical Grade Sapphire Manufacturing Growth Process for IR Window Applications

Air Force SBIR 10.1 Topic Descriptions

AF101C-001

TITLE: Optical Grade Sapphire Manufacturing Growth Process for IR Window Applications

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Develop and validate a production ready Sapphire growth process suitable for the manufacture of IR sensor windows used in military applications.

DESCRIPTION: The increased use of high resolution Infrared (IR) sensors is leading to demand growth for high optical purity sapphire for AF systems. Sapphire aerospace windows play an instrumental role in protecting onboard imaging, sensing, and targeting systems, while allowing mid-wave IR transmission. However, current use of sapphire for IR window applications is both size and cost limited. Emerging applications require window sizes of approximately 14" x 20" (280in² @ a minimum finished thickness of 0.8in) to allow for unobstructed sensing without the need for seams or mullions, which distort images. Additionally, in multi-paned applications, process induced variability within the sapphire itself can increase image distortion. Baseline cost for IR window grade sapphire is ~\$337/in² for thicknesses greater than 0.5 inches. The focus of this effort will be to develop and demonstrate advanced sapphire crystal growth processes which allow for production of large IR windows with transmittance goals greater than 99 percent of the theoretical value over the wavelength region from 0.4 - 5 microns and index homogeneity less than 4 ppm, over the entire window. Initial focus should concentrate on developing a stable, repeatable process for window sheets approximating 14" x 20" (280in² @ a minimum finished thickness of 0.8in). Later focus will be on process scale up to accommodate sizes ranging up to 18" x 35" (630in² @ a minimum finished thickness of 0.8in). Since the end goal of this effort is development of a production representative process, the rate, process control, quality, repeatability and reliability will be critical elements to be demonstrated. Special emphasis will be given to the demonstration of processes which: 1), allow for higher strength growth directions – i.e., those leveraging C-Plane surface orientation; and/or 2), reduce cycle times and costs of downstream processing such as lapping and polishing – near net shape. Higher strength can be fabricated at a lower weight while still meeting Air Force user requirements. Reduced post processing lowers cycle time and cost. Additionally, development of a detailed business case is required to show that the optimized sapphire window growth solutions are competitive with existing processes in term of cost, quality, lead and cycle times, work in process, etc.

PHASE I: Develop and demonstrate the feasibility (to MRL 4) of sapphire IR window growth processes as described above. Deliverables: A manufacturing process development plan with progress and completion performance goals and transition plan for drop in replacement to an end user.

PHASE II: Develop and demonstrate to MRL 7, a prototype sapphire window production process based on Phase I. Demonstrate process on a full-scale, representative sapphire window component. Demonstration components should be selected in conjunction with an aircraft production partner's inputs. The prototype system and associated process must be shown to be controllable and repeatable.

PHASE III DUAL USE COMMERCIALIZATION:

Military Application: DoD IR sensing applications, specifically navigation and targeting sensors. IR countermeasures, reconnaissance and surveillance systems, and transparent armor applications. RAD Hard electronics.

Commercial Application: IR bar code scanning devices. Commercial aircraft navigation systems. Medical scanners. Spectroscopy systems. Watch crystals. Blue LED devices. Semiconductor substrates.

REFERENCES:

1. Effects of Crystal Orientation and Temperature on the Strength of Sapphire, F. Schmid and D. C. Harris: J. Am. Ceram. Soc., 81, 885 (1998).

2. Neutron Irradiation for Sapphire Comprehensive Strengthening - II. Physical Property Changes, T. M. Regan, D. C. Harris, D. W. Blodgett, K. C. Baldwin, J. A. Miragliotta, M. E. Thomas, M. J. Linevsky, J. W. Giles, T. A. Kennedy, M. Fatemi, D. R. Black, and K. P. D. Lagerlöf: *Journal of Nuclear Materials*, 300, 47 (2002).

3. Manufacturing Readiness Assessment Background Information. Link: <http://dodmrl.com/>

4. Additional information from TPOC on Sapphire Material Requirements, 1 page (uploaded in SITIS as Ref. #4, 12/22/09).

KEYWORDS: large area sapphire windows, c-plane orientation, crystal growth processes