MISSILE DEFENSE AGENCY (MDA)
14.B Small Business Technology Transfer (STTR)
Proposal Submission Instructions

INTRODUCTION

The Missile Defense Agency's (MDA) mission is to develop and deploy a layered Ballistic Missile Defense System (BMDS) to defend the United States, its deployed forces, allies, and friends from ballistic missile attacks of all ranges in all phases of flight.

The MDA Small Business Technology Transfer (STTR) Program is implemented, administrated, and managed by the MDA SBIR/STTR Program Management Office (PMO), located within Advanced Technology (DV). Specific questions pertaining to the administration of the MDA STTR Program should be submitted to:

Missile Defense Agency
SBIR/STTR Program Office
MDA/DVR
Bldg 5224, Martin Road
Redstone Arsenal, AL 35898

Email: sbirsttr@mda.mil
Phone: 256-955-2020

Proposals not conforming to the terms of this Solicitation will not be considered. MDA reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality will be funded. Only Government personnel with active non-disclosure agreements will evaluate proposals.

Please read the entire DoD solicitation and MDA instructions carefully prior to submitting your proposal. Please go to http://www.sbir.gov/ipaper_download/385617 to read the STTR Policy Directive issued by the Small Business Administration.

Federally Funded Research and Development Centers (FFRDCs) and Support Contractors

The offeror's attention is directed to the fact that non-Government advisors to the Government may review and provide support in proposal evaluations during source selection. Non-Government advisors may have access to the offeror's proposals, may be utilized to review proposals, and may provide comments and recommendations to the Government's decision makers. These advisors will not establish final assessments of risk and will not rate or rank offeror's proposals. They are also expressly prohibited from competing for MDA SBIR or STTR awards in the SBIR/STTR topics they review and/or on which they provide comments on to the Government.

All advisors are required to comply with procurement integrity laws. Non-Government technical consultants/experts will not have access to proposals that are labeled by their proposers as "Government Only." Pursuant to FAR 9.505-4, the MDA contracts with these organizations include a clause which requires them to (1) protect the offerors' information from unauthorized use or disclosure for as long as it remains proprietary and (2) refrain from using the information for any purpose other than that for which it was furnished. In addition, MDA requires the employees of those support contractors that provide technical analysis to the SBIR/STTR Program to execute non-disclosure agreements. These agreements will remain on file with the MDA SBIR/STTR PMO.

Non-Government advisors will be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to perform their respective duties. In accomplishing their duties related to the source selection process, employees of the aforementioned organizations may require access to proprietary information contained in the offerors' proposals.

OFFEROR SMALL BUSINESS ELIGIBILITY REQUIREMENTS

Each offeror must qualify as a small business at time of award per SBA's regulations at 13 CFR 121.701-121.705 and certify to this in the Cover Sheet section of the proposal. Additionally, in accordance with the Small Business Administration's (SBA) STTR Program Policy Directive dated 18 October 2012, offerors must re-certify at certain points during the Phase I and Phase II period of performance to ensure that the awardee is in compliance with the program's requirements.

SBA COMPANY REGISTRY

Per the STTR Policy Directive, all STTR applicants are required to register their firm at SBA's Company Registry prior to submitting an application. Upon registering, each firm will receive a unique control ID to be used for submissions at any of the 11 participating agencies in the SBIR or STTR programs. For more information, please visit the SBA's Firm Registration Page: http://www.sbir.gov/registration.

ORGANIZATIONAL CONFLICTS OF INTEREST

Contract awards to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees which may be a violation of federal law. Proposing firms should contact the MDA SBIR/STTR PMO for further guidance in this situation.

The basic rules are covered in FAR 9.5 as follow (the Contractor is responsible for compliance):

(1) the Contractor's objectivity and judgment are not biased because of its present or planned interests which relate to work under this contract;

(2) the Contractor does not obtain unfair competitive advantage by virtue of its access to non-public information regarding the Government's program plans and actual or anticipated resources; and

(3) the Contractor does not obtain unfair competitive advantage by virtue of its access to proprietary information belonging to others.

All other applicable rules under the FAR Section 9.5 apply to Contractors.

USE OF FOREIGN NATIONALS

See the "Foreign Nationals" section of the DoD STTR Program solicitation for the definition of a Foreign National (also known as Foreign Persons).

ALL offerors proposing to use foreign nationals MUST disclose this information regardless of whether the topic is subject to export control restrictions. Identify any foreign citizens or individuals holding dual citizenship expected to be involved on this project as a direct employee, subcontractor, or consultant. For these individuals, please specify their country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. You may be asked to provide additional information during negotiations in order to verify the foreign citizen's eligibility to participate on a STTR contract. Supplemental information provided in response to this

paragraph will be protected in accordance with the Privacy Act (5 U.S.C. 552a), if applicable, and the Freedom of Information Act (5 U.S.C. 552(b)(6)).

Proposals submitted with a foreign national listed will be subject to security review during the contract negotiation process (if selected for award). If the security review disqualifies a foreign national from participating in the proposed work, the contractor may propose a suitable replacement. In the event a proposed foreign person is found ineligible to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale.

EXPORT CONTROL RESTRICTIONS

The technology within some MDA topics is restricted under export control regulations including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR). ITAR controls the export and import of defense-related material and services. EAR controls military and commercial items not listed on the USML or any other export control lists. EAR regulates export controlled items based on user, country, and purpose. You must ensure that your firm complies with all applicable export control regulations. Please refer to the following URLs for additional information: http://www.pmddtc.state.gov/compliance/index.html and http://www.bis.doc.gov/index.php/.

Proposals submitted to export control-restricted topics will be subject to security review during the contract negotiation process (if selected for award). In the event a firm is found ineligible to perform proposed work, the contracting officer will advise the offeror of any disqualifications but may not disclose the underlying rationale.

CLAUSE H-08 PUBLIC RELEASE OF INFORMATION (Publication Approval)

Clause H-08 pertaining to the public release of information is incorporated into all MDA SBIR and STTR contracts. All materials which relate to work performed by the contractor under MDA SBIR and STTR contracts must be submitted to MDA for review and approval prior to release to the public. Subcontractor public information materials must be submitted for approval through the prime contractor to MDA.

FRAUD, WASTE, AND ABUSE

To Report Fraud, Waste, or Abuse, Please Contact:

MDA Fraud, Waste & Abuse
Hotline: (256) 313-9699
MDAHotline@mda.mil

DoD Inspector General (IG) Fraud, Waste & Abuse
Hotline: (800) 424-9098
hotline@dodig.mil

Additional information on Fraud, Waste and Abuse may be found in the DoD Instructions of this solicitation; sections 3.6 and 4.19.

PROPOSAL FUNDAMENTALS

Proposal Submission

All proposals MUST be submitted online using the DoD SBIR/STTR submission system (http://www.dodsbir.com/submission). Any questions pertaining to the DoD SBIR/STTR submission system should be directed to the DoD SBIR/STTR Help Desk: 1-866-724-7457.

Classified Proposals
Classified proposals are not accepted under the MDA STTR Program. Contractors currently working under a classified MDA STTR contract must use the security classification guidance provided under that contract to verify new STTR proposals are unclassified prior to submission. Phase I contracts are not typically awarded for classified work. However, in some instances, work being performed on Phase II proposals will require security clearances. If a Phase II contract will require classified work, the proposing firm must have a facility clearance and appropriate personnel clearances in order to perform the classified work. For more information on facility and personnel clearance procedures and requirements, please visit the Defense Security Service Web site at: http://www.dss.mil/index.html.

Communication
All communication from the MDA SBIR/STTR PMO will originate from the sbirsttr@mda.mil email address. Please white-list this address in your company's spam filters to ensure timely receipt of communications from our office.

Proposal Status
The MDA SBIR/STTR PMO will distribute selection and non-selection email notices to all firms who submit a MDA STTR proposal. The email will be distributed to the "Corporate Official" and "Principal Investigator" listed on the proposal coversheet. MDA cannot be responsible for notification to a company that provides incorrect information or changes such information after proposal submission.

Debriefing
MDA will provide a proposal debriefing in writing to unsuccessful offerors. Requests for debriefing must be submitted in writing to the MDA SBIR/STTR PMO within 30 calendar days of non-selection notification. Non-selection notifications will provide instructions for requesting a proposal debriefing.

Discretionary Technical Assistance (DTA)
Section 9(b) of the STTR Policy Directive allows agencies to enter into agreements with vendors to provide technical assistance to STTR awardees, which may include access to a network of scientists and engineers engaged in a wide range of technologies or access to technical and business literature available through on-line data bases.

The purpose of this technical assistance is to assist STTR awardees in:
- Making better technical decisions on STTR projects;
- Solving technical problems that arise during STTR projects;
- Minimizing technical risks associated with STTR projects; and
- Commercializing the STTR product or process.

MDA may provide up to $5,000 of STTR funds for the technical assistance described above per year (for each year of the original award period of performance) for each Phase I award and each Phase II award. The amount will be in addition to the award and is not subject to any profit or fee by the requesting (STTR) firm and is inclusive of all indirect rates.

Alternatively, an STTR firm may acquire the technical assistance services described above itself and not through the vendor selected by the agency. Firms must request this authority from MDA and demonstrate in its STTR proposal that the individual or entity selected can provide the specific technical services needed. The DTA provider may not be the requesting firm, an affiliate of the requesting firm, an investor of the requesting firm, or a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g. research partner or research institution).

If the awardee demonstrates this requirement sufficiently, MDA will permit the awardee to acquire such technical assistance itself, in an amount up to $5,000, as an allowable cost of the STTR award. The per year amount will be in addition to the award and is not subject to any profit or fee by the requesting firm and is inclusive of all indirect rates. Requests for DTA funding outside of the Phase I or Phase II proposal submission will not be considered.

PHASE I PROPOSAL GUIDELINES

The DoD SBIR/STTR Proposal Submission system (available at http://www.dodsbir.net/submission) will lead you through the preparation and submission of your proposal. Read the front section of the DoD solicitation for detailed instructions on proposal format and program requirements. Proposals not conforming to the terms of this solicitation will not be considered.

MAXIMUM PHASE I PAGE LIMIT FOR MDA IS 20 PAGES

Any pages submitted beyond the 20-page limit within the Technical Volume (Volume 2) will not be evaluated**. Your Proposal Cover Sheet (Volume 1), Cost Volume (Volume 3), and Company Commercialization Report (Volume 4) DO NOT count toward your maximum page limit.**

Phase I Proposal

A complete Phase I proposal consists of four volumes:

Volume 1: Proposal Cover Sheet
Volume 2: Technical Volume
Volume 3: Cost Volume
Volume 4: Company Commercialization Report

MDA intends for the Phase I effort to determine the merit and technical feasibility of the concept. The contract period of performance for Phase I shall be six (6) months and the award shall not exceed $100,000. A list of topics currently eligible for proposal submission is included below, followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time. Phase I Option funding is not available under the MDA STTR Program.

PHASE I PROPOSAL SUBMISSION CHECKLIST

All of the following criteria must be met or your proposal will be REJECTED.

____1. The following have been submitted electronically through the DoD submission site by 6 a.m. (ET) 22 October 2014.

_____ a. Volume 1: DoD Proposal Cover Sheet

_____ b. Volume 2: Technical Volume (DOES NOT EXCEED 20 PAGES)**: Any pages submitted beyond this will not be evaluated. Your Proposal Cover Sheet, Cost Volume, and Company Commercialization Report DO NOT count toward your maximum page limit.**

_____ c. If proposing to use foreign nationals; identify the foreign national(s) you expect to be involved on this project, the type of visa or work permit under which they are performing, country of origin and level of involvement.

_____ d. Volume 3: Cost Volume. **(<u>Online Cost Volume form is REQUIRED by MDA</u>)**

_____ e. Volume 4: Company Commercialization Report. (required even if your firm has no prior SBIR/STTR awards).

____2. The Phase I proposed cost does not exceed $100,000.

____3. Your firm must be registered with SBA's Company Registry.

MDA PROPOSAL EVALUATIONS

MDA will evaluate and select Phase I and Phase II proposals using scientific review criteria based upon technical merit and other criteria as discussed in this solicitation document. MDA reserves the right to award none, one, or more than one contract under any topic. MDA is not responsible for any money expended by the proposer before award of any contract. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

MDA Phase I and Phase II proposals will be evaluated based on the criteria outlined below, including potential benefit to the Ballistic Missile Defense System (BMDS). Selections will be based on best value to the Government considering the following factors which are listed in descending order of importance:

a) The soundness, technical merit, and innovation of the proposed approach and its incremental progress toward topic or subtopic solution.
b) The qualifications of the proposed principal/key investigators, supporting staff, and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.
c) The potential for commercial (Government or private sector) application and the benefits expected to accrue from this commercialization.

In Phase I and Phase II, firms with a Commercialization Achievement Index (CAI) at or below the 20th percentile will be penalized in accordance with the DoD program solicitation.

Please note that potential benefit to the BMDS will be considered throughout all the evaluation criteria and in the best value trade-off analysis. When combined, the stated evaluation criteria are significantly more important than cost or price.

It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Technical reviewers will base their conclusions on information contained in the proposal. Relevant supporting data such as journal articles, literature, including Government publications, etc., should be contained in the proposal and will count toward the applicable page limit.

Qualified advocacy letter(s) will count towards the proposal page limit and will be evaluated towards criterion C. Advocacy letters are not required for Phase I or Phase II.

A qualified advocacy letter is from a relevant commercial or Government Agency procuring organization(s) working with MDA, articulating their pull for the technology (i.e., what BMDS need(s) the technology supports and why it is important to fund it), and possible commitment to provide additional funding and/or insert the technology in their acquisition/sustainment program. This letter should be included as the last page(s) of your technical upload. Advocacy letter(s) which are faxed or e-mailed separately will NOT be considered.

PHASE II PROPOSAL SUBMISSION

Per DoD STTR Phase II Proposal guidance, all Phase I awardees from the 14.B Phase I solicitation will be permitted to submit a Phase II proposal for evaluation and potential award selection. Details on the due date, content, and submission requirements of the Phase II proposal will be provided by the MDA SBIR/STTR Program Management Office either in the Phase I award contract or by subsequent notification. Only firms who receive a Phase I award resulting from the 14.B solicitation may submit a Phase II proposal. The one and only time that Phase II proposals based on the 14.B Phase I awards may be submitted by Phase I awardees from the 14.B solicitation is during this 14.B Phase II solicitation window.

MDA will evaluate and select Phase II proposals using the Phase II evaluation criteria listed in the DoD Program Solicitation. Due to limited funding, MDA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

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 MDA Phase II award timeframe. If you do not have a DCAA approved accounting system, this will delay/prevent Phase II contract award.

Approved for Public Release
14-MDA-7811 (8 May 14)

MDA STTR 14.B Topic Index

MDA14-T001	Integrated Health Sensing for Highly Efficient Weapon Inspection and Sustainment
MDA14-T002	Failure Avoidance in Microelectronics Due to Coefficient of Thermal Expansion (CTE) Mismatch of Substrates and Adhesives
MDA14-T003	Base Metal Electrode Capacitor Test Methods
MDA14-T004	Measurement of Remaining Effective Stabilizer in Solid Propellants

MDA STTR 14.B Topics by Research Area

DP-GMD (GM)

MDA14-T001	Integrated Health Sensing for Highly Efficient Weapon Inspection and Sustainment

QS-Quality, Safety & Mission Assurance (QS)

MDA14-T002	Failure Avoidance in Microelectronics Due to Coefficient of Thermal Expansion (CTE) Mismatch of Substrates and Adhesives
MDA14-T003	Base Metal Electrode Capacitor Test Methods
MDA14-T004	Measurement of Remaining Effective Stabilizer in Solid Propellants

MDA STTR 14.B Topic Descriptions

MDA14-T001 TITLE: Integrated Health Sensing for Highly Efficient Weapon Inspection and Sustainment

TECHNOLOGY AREAS: Sensors

OBJECTIVE: Research and develop innovative manufacturing solutions that integrate embedded health status monitoring for critical weapon electronic printed circuit board (PCB) assemblies within cost and performance constraints. Create a capability for highly efficient inspection and sustainment that enhances overall affordability through reduced consumption, minimized dependence on funding resources, and maximum weapon service life. Address cost and performance barriers inherent with manufacturing embedded health sensing, to achieve an acceptable Return-on-Investment (ROI) and risk level with transition to realize tangible service life extension and sustainment benefits.

DESCRIPTION: Integrated health monitoring can positively impact a broad class of critical weapon components; however this effort concentrates on electronic circuit card assemblies. Manufacturing solutions will be developed to integrate micro-electro-mechanical system (MEMS) devices that measure key parameters (temperature / humidity / shock / vibration exposure) which translate into failure potential of the component. Signal conditioning/processing, power, and interfaces must also be addressed. The general requirements for this function relate to negligible impact on the host component's performance, cost, and reliability; extremely low volume to minimize needed PCB real estate; and accurate parameter measurement. The capability requires extremely low power sensors and extremely low power analog and digital signal processing to achieve more than 10 years of operation. This topic is not seeking any battery research and/or battery development for health monitoring systems.

For the purpose of this effort, goals for system power are less than 50 microwatts continuous power consumption in sleep mode and less that 10 milliwatts continuous power consumption in active mode. Volume and weight goals for the electronic health monitoring system (without battery) are: volume smaller than (1 x 1 x 0.2 inches) and weight less than 0.36 ounce (10 grams). System power should be derived from a combination of power supplied by the host PCB and from a battery when host PCB power is unavailable. Design should include hardwired external interface via host PCB. Sensors for humidity, temperature, rate of temperature change, and dynamic environment (shock loading as a minimum) should also be addressed.

PHASE I: Describe proposed manufacturing improvements that achieve a highly integrated low-power/low-volume embedded health monitoring solution, including diagrams and descriptions of: (1) proposed sensors, (2) analog signal processing chain(s), (3) analog-to-digital converter(s), (4) digital signal processing chain(s), and (5) any post digital processing, and/or linearization required to convert the digitized sensor values to measurement values. Demonstrate the feasibility of the proposed health monitor system, using models, simulations, and/or proof of principle devices. Describe the resulting improved manufacturing processes in terms of quantifiable key manufacturing metrics that culminate in an embedded health monitor with the following capability attributes: (1) operation, (2) estimated system performance, (3) estimated power consumption for each individual element, and the total system power, (4) estimated operating temperature range, (5) estimated operational vibration limits, (6) estimated operational lifetime, and (7) estimated non-powered lifetime (shelf lifetime).

PHASE II: Working with one or more program elements within MDA, identify systems, subsystems, or components where this technology can be applied and develop and implement a small scale test to verify and validate the utility of the technology in a system, subsystem or component.

PHASE III: Assess the utility of these solutions (by analysis) in context of the original high-level objectives of this effort to assure reliability through streamlined mandated inspections, surveillance, and other sustainment processes with accurate status indication via integrated sensing. Work with program elements within MDA to implement the technology within system(s), subsystems, or component(s).

COMMERCIALIZATION: Solutions may benefit military, aerospace, medical and industrial applications requiring low power electronic health monitoring systems for diagnostics and prognostics. Military systems (missiles, aircraft, ships, and vehicles) can use ultra-low power electronic health monitoring systems for system monitoring,

diagnostics and prognostics. The medical industry would benefit from ultra-low power electronic health monitoring systems for battery powered systems like heart pacemakers, blood glucose monitors, and other medical devices.

REFERENCES:
1. S. Kumar, E. Dolev, M. Pecht: “Parameter Selection for Health Monitoring of Electronic Products," Microelectronics Reliability, 50(2):161-168, Elsevier Ltd., 2010.

2. S. Misbra, S. Ganesan, M. Pecht and J. Xie: “Life Consumption Monitoring for Electronics Prognostics," 2004 IEEE Aerospace Conference Proceedings, pp 3455-3456, 2004.

3. P. Bradford: “Power Consumption and Health Monitoring Systems,” Redstone Arsenal Energy 2010 Workshop, Redstone Arsenal, AL, September 2010. Available from https://rsic.redstone.army.mil

4. R. Kaushik, and S. Prasad: “Low Voltage CMOS VLSI Circuit Design,” Wiley, 1999, ISBN: 047111488X.

5. F. Shearer: “Power Management in Mobile Devices,” December 2007, ISBN-13: 9780750679589.

6. Phys.org: "Team develops world's most powerful nanoscale microwave oscillators," June 2012, http://phys.org/news/2012-06-team-world-powerfulnanoscale- microwave.html.

7. Y. Bando, and D. Golberg: “Synthesis and properties of nanotubes filled with solids, liquids and gases,” 5th IEEE Conference on Nanotechnology, pp. 1-2, 2005.

8. Phys.org: "New semiconductor research may extend integrated circuit battery life tenfold," 20 Jan 2013. http://phys.org/news/2013-01-semiconductor-circuit-battery-lifetenfold.html

KEYWORDS: electronic health monitoring, diagnostics, prognostics, low power, signal processing, microcontroller

MDA14-T002 TITLE: Failure Avoidance in Microelectronics Due to Coefficient of Thermal Expansion (CTE) Mismatch of Substrates and Adhesives

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Reduction of CTE induced stresses leading to failures in microelectronics due to a mismatch between the substrates and adhesives. Areas of concern are the development of methodologies for choosing the substrates and adhesives, the determination of associated metrics to ensure an appropriate selection has been made, and assurance that process parameters will not adversely impact the substrate/adhesive system.

DESCRIPTION: A common source of failure in microelectronics is due to induced stresses caused by a CTE mismatch between substrates and the adhesive bonding between them. This is especially evident in glass/metal bonds. Not only must adhesives be tailored to the substrates, but selection and quality assurance methodologies must be developed to ensure initial appropriate choices and on-going testing with metrics to ensure that the properties of the chosen adhesive do not differ between lots. Methodologies for initial selection must take into account the substrates, processing parameters downstream, and end item environmental conditions for delivery to use.

This topic is seeking models to predict the relative strengths of different adhesive/substrate combinations; testing criteria and conditions to validate those models and confirm choices for weapons systems, and appropriate language for insertion into current or new military and commercial specifications for adhesive use. Adhesives used in multiple applications such as bonding, potting, and coating, will be characterized such that these characteristics can be quantified by metrics usable by the developed models. Failure modes due to CTE mismatch interacting with design geometry must be identified and reduced to systems which can be modeled and validated. Effects of joint or use geometry must be identified as part of the design constraints. The results of this topic will provide design parameters to build robust systems that will withstand long term storage and high stress use environments.

PHASE I: Identify the amount of CTE mismatch that will cause a failure within microelectronics. Identify a plan to address the issue of CTE mismatch. Perform initial testing and/or modeling to characterize the amount of CTE mismatch required to cause a failure within microelectronics. All elements that can cause the CTE mismatch should be considered in the proposal (i.e., adhesive, substrate, geometry). Identify applicability of mitigation designs, techniques, materials and/or processes.

PHASE II: Perform in-depth validation testing of failures and/or model caused by CTE mismatch. s. Develop mitigation designs, techniques, materials and/or processes for military applications.

PHASE III: The contractor will work with applicable contractors to implement the design parameters, or other techniques to mitigate CTE failures in military systems.

COMMERCIALIZATION: The results of this project will have direct correlation to non-military applications, such as automotive systems, which will present near-term opportunities for commercialization, as well as for reliability prediction tools that can be integrated with general microcircuit reliability prediction tools, such as those that identify wear-out times under various use applications. The identification of methods to address CTE mismatch could be utilized in any technology that utilizes microelectronics.

REFERENCES:
1. B. Han: “Thermal Stresses in Microelectronics Subassemblies: Quantitative Characterization Using Photomechanics Methods," Journal of Thermal Stresses, 26:583–613, 2003.

2. B. Han and Y. Guo: “Determination of Effective Coefficient of Thermal Expansion of Electronic Packaging Components: A Whole-Field Approach," IEEE Trans. Components, Packaging and Manufacturing Tech. Pt. A, vol. 19, no. 2, pp. 240–247, 1996.

3. R. Prasher: "Thermal Interface Materials: Historical Perspective, Status, and Future Directions," Proceedings of the IEEE, 94 (8), 1571-1586, 2006.

4. MIL-STD-883J, Microcircuits, 2013.

KEYWORDS: Microelectronics, Coefficient of thermal expansion (CTE), adhesives

MDA14-T003 TITLE: Base Metal Electrode Capacitor Test Methods

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: The objective of this research and development effort is to identify and develop screening methods for Base Metal Electrode Capacitors.

DESCRIPTION: As capacitor technology continues to become micro miniature, the traditional high reliability manufacturing methods such as use of precious metal (palladium) electrodes can no longer be applied due to size reductions, voltage demands and the cost of palladium. The commercial market has moved to the use of base metal (typically nickel) electrode (BME) type capacitors to get the required number of dielectric layers into the smaller package size. In addition, BME dielectric thickness varies between manufacturers for the same voltage and capacitance ratings. Avalanche breakdown can occur because of small manufacturing defects (either a crack or deformity in the dielectric between metallization layers). Industry has not yet identified an appropriate screening method to screen defects in the dielectric layers of BME capacitors (e.g. surge current testing for tantalum type capacitors).

This project will develop reliability prediction models and screening, lot sampling, and qualification test methods to assure that BME capacitors meet military application requirements across the broad range of military application environmental and operating stresses. Military systems rely almost entirely on the commercial electronics industrial base that has transitioned from precious metal electrode capacitors to BME capacitors to reduce size. The commercial industrial base does not utilize lot testing to assess product and process performance, as most customer

requirements do not require that level of product assurance, but military systems typically have very high consequences of failure that require high confidence in product performance.

PHASE I: Identify BME capacitor's failure mechanisms likely to impact system performance and possible screening, lot testing, and qualification test requirements to assure BME capacitors perform as specified. Identify possible process control methods that the commercial industrial base could adopt to enhance capacitors reliability and quality. Develop test fixtures for BME capacitors down to the 0201 (0603 metric): 0.024" × 0.012" (0.6 mm × 0.3 mm) device size. Perform initial testing to validate methods to provide BME capacitors product assurance. Identify a possible method to screen manufacturing defects in the BME.

PHASE II: Implement the screening method(s), tests, and possible process control changes identified in Phase I in an MDA approved manufacturing facility to determine their effectiveness in enhancing device reliability and quality. Based on results, develop guidelines for implementing screening, test methods, and process changes in full scale production.

PHASE III: Work with industry partner(s) to validate the approaches developed in Phase II for various applications and employ them in the manufacturing devices for those applications.

COMMERCIALIZATION: The results of this project will have direct correlation to non-military applications, such as automotive systems, which will present near-term opportunities for commercialization, as well as for reliability prediction tools that can be integrated with general microcircuit reliability prediction tools, such as those that identify wear-out times under various use applications. The identification of methods to address defects in BMEs could be utilized in any technology that utilizes microelectronics.

REFERENCES:
1. C. Pollock, M. Petkova, A. Devoe: "COTS Reliability – All COTS Devices Are Not Created Equal," Presidio Components, Inc.

2. D. Donahue, C. Hillman: "Failures in Base Metal Electrode (BME) Capacitors," CARTS Proceeding, 124-28, 2003.

3. M. Cozzolino: "Should Base metal Electrode (BME) Ceramic Capacitors Be Accepted for High Reliability Space Usage?", Carts International 2013, March 25-28 2013.

4. R. Demcko: "BME for Military and Space," G11 Meeting, October 2012.

KEYWORDS: base metal electrodes, microelectronics, screening

MDA14-T004 TITLE: Measurement of Remaining Effective Stabilizer in Solid Propellants

TECHNOLOGY AREAS: Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.4 of the solicitation.

OBJECTIVE: Develop and demonstrate methodologies of quantitatively measuring the percentage of Remaining Effective Stabilizer (RES) in solid propellants. Depletion of stabilizer can result in decreased performance and service life of solid propellant.

DESCRIPTION: Composite and double-base solid propellants typically contain a small percentage by weight of stabilizers such as Diphenylamine or Ethyl Centralite. The purpose of stabilizers is to increase service life of solid propellant by minimizing certain chemical and physical degradation reactions associated with out-gassing of oxides of nitrogen and oxidation of the propellant binder and energetic nitrate esters. The effectiveness of the stabilizer

deteriorates over time, thus resulting in a reduction in overall propellant stability due to binder and nitrate ester degradation.

Current state-of-the-art techniques for determining solid propellant stabilizer content are described in MIL-STD-286C. These include techniques such as steam distillation spectrophotometric method, liquid chromatography, etc. All of these methods require a 5-10 gram sample of propellant be taken from the source to be measured. When the original source of propellant is of small quantity this limits the number of tests that can be conducted over time. Likewise, if the propellant being sampled is cast inside a motor, taking samples of propellant is not possible.

Desire innovative, non-destructive measurement techniques to determine the Remaining Effective Stabilizer (RES) in any given solid propellant formulation. Techniques should be capable of determining the amount (weight percent) of virgin stabilizer remaining in the propellant to +/- 5 percent accuracy. This should directly correlate to a remaining service life determination of the propellant. Of particular interest are techniques that employ methods of continuous monitoring of stabilizer in cast propellants. Also of interest are techniques that, along with measuring RES, are capable of determining the rate of out-gassing of oxides of nitrogen that is taking place within the propellant. This should be correlated to the rate of stabilizer depletion.

PHASE I: Develop a proof-of-concept solution; identify candidate measurement techniques, detail any hardware/software that may be developed, and validate concept through prototype testing.

PHASE II: Expand on Phase I results by maturing proof-of-concept solution to level necessary to repeatedly measure RES and demonstrate ability to correlate results to remaining service life of the propellant. Demonstrate developed measurement technique through testing propellant stabilizer and verify through methods defined in MIL-STD 286C.

PHASE III: The developed measurement technique should have direct application to real-world scenarios where propellant stability shall be determined. Conduct engineering and manufacturing development, test, evaluation, and qualification.

COMMERCIALIZATION: The technologies developed under this STTR topic should have applicability to defense industry as well as other potential applications such as commercial chemical industry.

REFERENCES:
1. MIL-STD-286C, “Propellants, Solid: Sampling, Examination and Testing" (28 Aug 1991).

2. George P. Sutton, "Rocket propulsion Elements; Introduction to Engineering of Rockets" 7th edition, John Willey & Sons, 2001.

KEYWORDS: solid propellant, stabilizer, HTPB, composite, propellant, measurement