

2020 Flexible Hybrid Electronics (FHE) Focused Solicitation Request for Proposals (RFP)

Issued: June 10, 2020

White Paper Responses Due Date: July 10, 2020 at 5:00pm PST

Full Proposals Due Date: September 4, 2020 at 5:00pm, PST

1. SEMI-FlexTech Mission/Objectives

SEMI-FlexTech is an industry-led, public/private partnership providing a common platform for flexible hybrid electronics (FHE) manufacturers/developers and their supplier base to develop the next generation of manufacturing equipment and materials. FlexTech's mission is to help develop the infrastructure required to support world-class manufacturing capability for FHE devices and products through a focused R&D program from TRL3 - TRL5 (See section 5). FlexTech will oversee and administer funds provided by the U.S. Government through the Army Research Laboratory (ARL) for this purpose.

Topics in this 2020 Solicitation are:

- A. FHE power and power integration
- B. Reliability as it applies to FHE
- C. Electronics environmental sustainability as it applies to FHE
- D. Heterogeneous packaging as it applies to FHE
- E. Materials
- F. Soft robotics

Further detail about each topic is listed the section titled Proposal Topic Detail, below.

Concept demonstrations (demos) must be part of the deliverables for consideration of an award.

2. Proposal Process and Topics

The proposal process will start with a white paper submission. Members of the FlexTech technical council will review the white papers and recommend those for full proposal submission. Point of contact for the submission will be invited to submit a full proposal. Full proposals will be evaluated by members of the FlexTech technical council based on a set of criteria that include budget, collaboration value, criticality of the problem addressed, relevance to the FHE ecosystem, schedule & milestones, deliverables, and overall proposal quality. White paper and full proposal content requirements are listed in sections 7 and 8. Typical FlexTech programs run from 9-18 months including a final report. No information considered to be company proprietary should be divulged.

In soliciting these proposals, FlexTech plans to grant and administer funding which should be matched (50% of total project cost requested) with funds in the form of cash and in-kind contributions provided by the grant recipients to cover the total project cost. If all other criteria are equal, preference will be given to proposals with a higher percentage of cost share. It should be noted that, historically, cost share for the ARL/FlexTech development program has averaged over 60% industry funding. Project Teams of skilled technical resources from FlexTech member companies will be identified to provide project

oversight and direction. These Project Teams typically will be comprised of 2 to 4 experts from the consortium companies and members from the successful individual supplier or supplier team.

In responding to this solicitation, partnering among industrial companies or industrial company/ R&D organization/university teams is appropriate and, in some cases, encouraged. Individual company responses are appropriate where company size, breadth and expertise are sufficient to cover effectively all areas (e.g., technical resources, financial stability, and market presence) critical to the successful completion of the proposal.

FlexTech will support technical approaches that are revolutionary, thus having a more significant element of risk, as well as approaches that are evolutionary improvements upon existing capability, which tend to be less risky and involve shorter development and delivery intervals. It is recognized that it may be desirable to include information that is considered confidential and proprietary by the submitter in order to fully and effectively convey the technical merits of the proposal. While a best effort will be made to restrict the proposal information to those with a need to know expressly for purposes of the review, it is recommended that the inclusion of proprietary information be limited to the minimum necessary to convey the highlights of the technical approach.

With respect to intellectual property developed under a FlexTech contract, the following policy has been established to encourage suppliers to cooperate with FlexTech and ARL in the accomplishment of their objectives:

“Legal title to any technology developed under a FlexTech funded research and development contract will be the property of the development partner.”

Development agreements generally will be awarded on an actual cost basis, not-to exceed contracts, with payments to be made quarterly and based on milestones as presented in the proposal. If your company has a U.S. government approved rate structure, use it. If not, the normal commercial cost accounting system used for internal R&D projects will be acceptable. The methods used to value “cost sharing” cost must be the same as those used to value the full project costs. All suppliers are expected to have a government approved or industry standard accounting system by which actual project costs are tracked and reported. This is an absolute requirement to be sure that cost share obligations are met.

A work breakdown structure should be the basis of project schedules, milestone definitions, and cost estimates. Cost estimates for each major step leading to completion of a milestone should be used as the basis for the amount from the grant to be paid. A spreadsheet showing these calculations should accompany each proposal. The same spreadsheet should also show the specifics of how you will contribute your matching share of the total costs of the development contract. Cost sharing expectations have been established in the master agreement between FlexTech and ARL, and a minimum 50/50 cost sharing ratio between government and industry is required.

3. Research and Development Award Budget

FlexTech prior solicitations have resulted in awards in the budgetary range of \$250k-\$500k, with an additional cost share from the award recipient matching or exceeding the cash award. Anticipation for this 2020 RFP solicitation is a cash budget range of \$400K - \$1M with an additional matching (or greater) cost share from the award recipient. Proposals may be from single institutions or a project team comprised of various companies and/or universities. Proposals from multi-institutional teams will be preferred.

4. Focused Solicitation

In partnership with Army Research Labs, FlexTech is soliciting technology development proposals for the following areas:

Part A – FHE Power and Power Integration - Power and power integration is the core of any integrated system and more specifically for flexible hybrid electronics with challenges to develop renewable, sustainable and reliable power system and integrate them to flexible hybrid electronics.

The purpose of this focused solicitation is to fund a recipient, a single team or multiple recipients and teams to conduct a R&D effort to develop and demonstrate the following:

In scope technologies:

- Thin flexible batteries reliability and sustainability
- Breakthrough/ New materials for batteries with improved power density and energy density
- Thin, light, long lasting flexible battery integration with reliability demonstration
- Energy harvesting
- FHE power system design, simulation, and optimization tools as the development of ultra-low power circuits and components with reliability demonstration
- Applications in mobiles (IoT, medical services, wearables, phones)

Out of scope for this focused solicitation is : FHE power or power integration without reliability characterization and performance demonstration.

Part B - Reliability as it applies to FHE - In recent years, R&D focused on FHE integrated systems, however, reliability remained a challenge for FHE and specifically for military application in harsh environment where temperature changes impact the performance and lifetime. Moreover, manufacturing processes of thin flexible batteries and components and attach processes remain challenging for commercialization.

The purpose of this focused solicitation is to fund a recipient, a single team or multiple recipients and teams to conduct a R&D effort to develop and demonstrate the following:

In scope technologies:

- Demonstration of successful reliability out to point of failure of FHE integrated systems in harsh environments for example substrate, sensor, chip, adhesive materials in temperature > 70C deg, salt/corrosive environment, moisture, high G,...
- Accelerated lifetime test based on Physics of failure
- Exhausted failure analysis

Out of scope for this focused solicitation: Reliability of conventional integrated circuits.

Part C – Electronics environmental sustainability as it applies to FHE- Sustainable electronics will enable us to protect the environment and enhance human health and well-being over generations while minimizing adverse lifecycle impacts of devices/materials

The purpose of this focused solicitation is to fund a recipient, a single team or multiple recipients and teams to conduct a R&D effort to develop and demonstrate the following:

In scope technologies:

- FHE materials
 - Reusability, Disposability, Recyclability, Biodegradation
- Sustainable manufacturing- conservation of energy and natural resources
- Sustainable processing -reduction in water usage, RHS and CO2 footprint

Out of scope out scope for this focused solicitation: No consideration of environmental impact of technology.

Part D – Heterogeneous packaging as it applies to FHE- Heterogeneous Integration is essential to maintain the pace of progress with higher performance, lower latency, smaller size, lighter weight, lower power and reliability requirements.

The purpose of this focused solicitation is to fund a recipient, a single team or multiple recipients and teams to conduct a R&D effort to develop and demonstrate the following:

In scope technologies:

- 2.5D or 3D integration with FHE
- Additive processing with fine lines and pads with pads separation of <10um
- FHE sensor integration for example:
 - Temperature sensors with accuracy of 0.1C deg and long lifetime
 - Impact sensor to withstand high G shock without drift
 - Gas sensor with high selectivity
- Antenna with high frequency e.g. mm wave applications
- Printed replacement/enhancement to MEMS

Out of scope for this focused solicitation: Not to duplicate the activities in Heterogenous roadmap or any funding under SHIP

Part E – Materials - This topic is about the evolution of materials providing a wider range of properties for conductors, semiconductors and insulators to meet demand for lower cost, reduced power, higher thermal density and higher performance. This topic also extends into development of materials for improvement of modules and packages.

The purpose of this focused solicitation is to fund a recipient, a single team or multiple recipients and teams to conduct a R&D effort to develop and demonstrate the following:

In scope technologies:

- Materials with low K dielectrics with higher resistance to mechanical stress
- Low and high K dielectric with high breakdown voltages
- Low cost conductor and dielectric materials with CTE match for silicon integration
- Low cost dielectrics with high thermal conductivity
- Development of Metamaterials in FHE (Antenna (RF), shielding, optical metamaterials -SWaP
- AI for new material introduction; AI for process optimization; AI yield optimization

Out of scope for this focused solicitation: Any duplication with other co-funded government projects (DARPA)

Part F – Soft Robotics- Soft robotics as a means for optimizing the Human-Machine Interface (HMI), can improve operational efficiencies, augment human performance and capabilities, and accelerate information processing for making decisions, taking action, and enhancing safety.

The purpose of this focused solicitation is to fund a recipient, a single team or multiple recipients and teams to conduct a R&D effort to develop and demonstrate the following:

In scope technologies:

- Integrated actuators, sensors, embedded electronics
- Stretchable electronics for example artificial skins
- Prosthetics
- FHE materials, sensor system and AI for HMI and augmentation

Out of scope for this focused solicitation: Any duplication with other co-funded government projects

5. TRL Entry and Exit Level Definitions

TRL 3. Analytical and experimental critical function and/or characteristic proof of concept

- Active R&D is initiated (beyond basic principle observation)
- Includes analytical studies and laboratory studies to physically validate analytical predictions of separate technology elements
- Examples include components that are not yet integrated or representative

TRL 4. Component and/or breadboard **validation** in laboratory environment

- Basic technological components are integrated to establish that they will work together
- Relatively “low fidelity” compared with the eventual system
- Examples include integration of “ad hoc” hardware in the laboratory

TRL 5. Component and/or breadboard **validation** in relevant environment

- Fidelity of breadboard technology increases significantly
- Basic technological components are integrated with reasonably realistic supporting elements so they can be tested in a simulated environment
- Examples include “high-fidelity” laboratory integration of components

- **Additional Information** on the Technology and Manufacturing Readiness Assessment process can be found at:

TRL Assessment: <https://api.army.mil/e2/c/downloads/404585.pdf>

6. Requirements for Receiving an Award

In order to submit a response to this FlexTech RFP and subsequently to be considered for an award, several requirements must be met as detailed below.

- To receive an award from FlexTech, the company or composite team of companies must have a significant presence in the United States in the form of R&D activities and/or manufacturing. At least 50% of the work activity (funds) must be spent within the U.S. operations. The primary company leading the proposal must be a U.S.-owned company. Further, for the period of award performance plus the 3 years following, the primary company plus all IP resulting from said

award must remain under control of a U.S.-owned or majority-controlled company. In certain cases, where it can be demonstrated that the development is both critical to U.S. manufacturing capability and unique, this “preference for U.S. operations” requirement can be waived with ARL approval. Any responding company requiring such a waiver must make this known in the pre-proposal document.

- The company or companies must be committed to volume manufacturing of the developed products and provision to the U.S. FHE industry on a right-of-first acceptance basis. Applied research conducted by universities will be considered and does not need to meet this requirement. However, in this latter case a pathway to commercialization and or licensing must be envisioned and described.
- The company or companies, including universities, must provide a matching share of the development cost in cash and in-kind contributions (e.g., labor and materials) - 50% recommended.
- Companies and organizations which are selected for an award, including all partners and/or subcontractors, must subsequently join SEMI at the appropriate membership level. Membership information is available at <https://www.semi.org/en/connect/semi-membership-levels>
- Companies and organizations which are selected for an award, including all partners and/or subcontractors, must agree to terms and conditions set forth in the SEMI FlexTech Development Agreement before receiving any portion of the award.

7. White Paper Instructions

White paper submissions should be 5 pages (including any cover pages, tables of contents, figures, etc.) or less and contain a description of the proposed idea, high level budget, timeline, and background/experience of the R&D team. In addition, the submission should clearly outline the problem being addressed and how the proposed idea would solve the challenge. The current state of the art and the advancement the proposed idea has over that state of the art should be discussed. In addition, the value to the FHE ecosystem and potential path to commercialization should also be outlined. White paper submissions do not have to adhere to a specific format (other than maximum page length), but it may be useful to review the full proposal instructions in section 8 for suggested content.

White papers will only be accepted electronically up to 5:00 PM PT on the due date of July 10, 2020. Please submit your completed proposal via email to rfp2020@semi.org.

8. Full Proposal Instructions

The format below will help us evaluate your proposal and ensure that the major topic areas are covered. A full proposal is typically 20 pages with a page limit of 35 pages.

Content: The proposal shall comply with the following content and structure.

Page 1: Cover Page

Date

Project Title

Company Name

Address

CAGE/DUNS

Project Leader Contact Information (telephone and email)

Project Team (Prime & Subs)

Project Duration

Total Project Cost

Cost Share

FlexTech Funds Requested

Page 2: Table of Contents

Page 3: Executive Summary, containing a short description of the project objective and industry or supply chain impact

Pages 4-35: Proposal Content

1. Project Proposal
 - 1.1. Problem definition
 - 1.2. Project scope and objectives
 - 1.3. Technical approach, rationale and innovative claims with supporting data and diagrams
 - 1.4. Performance target metrics and/or specifications
 - 1.5. Prior work, current status, and results (if any)
2. Statement of Work
 - 2.1. Project management approach
 - 2.1.1. Roles and relationships of key personnel and institutions
 - 2.1.2. Lead institution and subcontract partners
 - 2.2. Project schedule

- 2.3. Detailed task description
 - 2.4. Milestones, deliverables including demonstration prototypes, reports, process definition, test results, reviews etc.
 - 3. Detailed Project Cost and Cost Share by Task or by Quarter
 - 3.1. labor, materials, overhead, and capital
 - 4. Project Risk Assessment
 - 4.1. Table: Analysis of Risk and Mitigation Strategy (list risk assessment tools/processes used if any)
- | Risk | Consequence | Mitigation Strategy | Impact (L,M,H) |
|------|-------------|---------------------|----------------|
|------|-------------|---------------------|----------------|
- 5. Market Needs and Competitive Landscape
 - 5.1. Business justification
 - 5.1.1.Existing product portfolio
 - 5.1.2.Primary markets served and major customers
 - 5.2. Commercialization strategy for target markets
 - 5.3. Cost of ownership benefits of proposed technology in absolute terms or relative to the cost of the typical current process
 - 6. Company Background and Capability to Meet Technical and Business Targets
 - 6.1. Team & key personnel
 - 6.1.1.Management and technical personnel experience and qualifications
 - 6.2. Facilities and equipment
 - 6.3. Relevant company information
 - 6.3.1.Three year financial performance track
 - 6.3.2.Staff size and make-up by function
 - 6.3.3.IP strategy, key previous innovative developments and intellectual property (patents) held related to the proposal topic
 - 7. Contact Information for Technical Lead, Alternative Technical Representative, and Contract Representative
 - 8. Appendix (if needed - NOT INCLUDED IN PAGE TOTAL)
 - 8.1. Technical References
 - 8.2. Letters of Support

Full Proposals will only be accepted electronically up to 5:00 PM PDT on the due date of September 4, 2020. Please submit your completed proposal via email to rfp2020@semi.org.

9. Proposal Evaluation

Upon receipt, proposals will be forwarded to the FlexTech Technical Council members for review. During the final selection process of proposals, some communication or negotiation between the potential

supplier and representatives of FlexTech may be initiated over the terms, conditions, specifications, deliverables, schedule or other relevant factors contained in the proposal in advance of awarding of a contract. Granting of any awards to proposals submitted in response to this RFP is contingent upon the continued availability of funding from the U.S. Government.

10. 2020 RFP Schedule

June 10, 2020	RFP Issued
June 17, 2020	Webinar will start at 9 AM. Register in advance at the link in section 11.
July 10, 2020	White Paper Due
August 4 2020	Notification of White Paper Acceptance and Full Proposal Request
September 4 2020	Full Proposals Due
October 5, 2020	Notification of Award (each full proposal point of contact will be notified)

RFP Schedule subject to change based on availability of review personnel, commitment of federal funds, and other factors.

11. Resources

Information on past awardees and RFPs can be found at www.flextech.org and semi.org.

A webinar will be held on June 17, 2020 at 9:00 AM Pacific Time to review white paper and proposal requirements and answer any questions from the public.

Webinar registration link: <https://register.gotowebinar.com/register/3163351435508307471>

12. Current Members of the FlexTech Governing and Technical Councils

Applied Materials, Inc.	NextFlex
Binghamton University	NXP
Chasm Advanced Materials, Inc.	PARC
Cornell University	Qualcomm
E Ink Corporation	SAFI-Tech
EMD Performance Materials [Merck KGaA]	SEMI
GE	Teledyne DALSA Semiconductor Inc. (TDSI)
Microchip	ThinFilm Electronics
Molex	US Army Futures Command, ARL

13. Contact Information

Communication and questions during the proposal period should be directed to rpf2020@semi.org.