DARPA NESD

INDUSTRY GROUP

The ***Biological Technologies Office (BTO)*** of the ***Defense Advanced Research Projects Agency (DARPA)*** is sponsoring an Industry Group to support the ***Neural Engineering System Design (NESD) Program***.

NESD is a highly interdisciplinary program requiring extensive integration of new research and technology. To facilitate the development and adoption of NESD technologies, DARPA has organizedan industry group for potential proposers. Members of this group have agreed to provide access to rapid prototyping and manufacturing of advanced neuro-engineering components, including state-of-the-art electronics, photonics, computing, assembly and packaging.

This document contains all responses to **Special Notice 16-17** as of March 10, 2016. Any updates will be posted at **http://www.darpa.mil/work-with-us/opportunities**.

Allen Institute for Brain Science

Primary Contact

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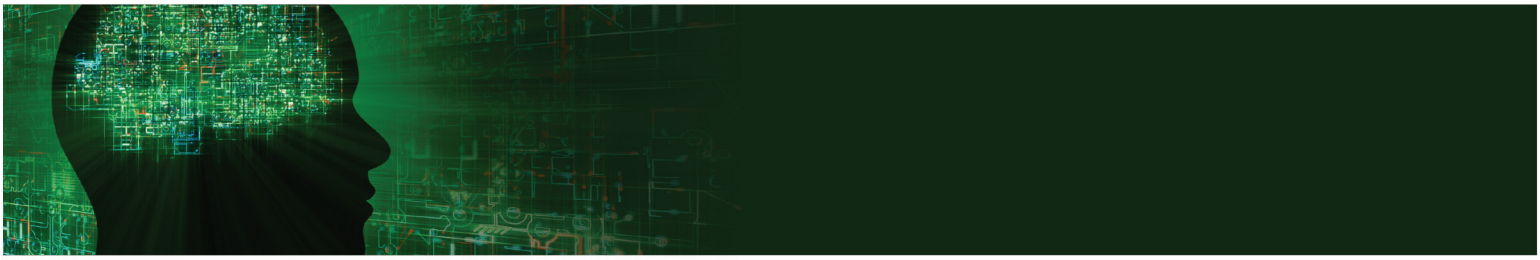
About

The Allen Institute for Brain Science is an independent, non-profit medical research organization that has embarked on a concerted, ten-year effort, involving more than 300 scientists, engineers, technologists and other specialists, to understand the cerebral cortex in the mouse and in the human at the cellular level. We are built upon the notion of Big Science, Team Science and Open Science in the service of Basic Science with an explicit mission to accelerate understanding of the human brain in health and disease. Our data are freely and publicly available at www.brain-map.org.

Capabilities

- We seek to experimentally and computationally characterize the components (cell types) of the rodent visual thalamo-cortical system at the molecular, transcriptional, electron-microscopic, electrophysiological, morphological and functional levels to study how these components integrate information to generate high-level cognitive functioning such as object recognition.
- To study such high-level functioning, we use various in vivo perturbation and monitoring techniques (e.g. optical stimulation, extracellular depth recordings, wide and narrow-field Ca-imaging, etc.), very high density silicon probes (364 probes per shaft) as well as state-of-the art computer models that capture cortical information processing at varying levels of granularity.
- To understand the human brain, the Institute is also engaged in cell typing from human brain tissue harvested from patients undergoing brain surgery.
- Thus, we are routinely recording intracellularly from single and multiple cells from ex vivo human lateral temporal cortex and as well as performing morphological characterization on these same cells).



Capabilities

- We also have extensive experience with the genomic and transcriptional architecture of the human brain.
- We are interested in applying this knowledge for medical and translational purposes and to help facilitate advancement of CNS disorder therapies.

Facilities II

The Allen Institute headquarters, a 270,000 square foot life sciences building, is located in Seattle's South Lake Union neighborhood, the city's biotechnology hub. We are a high-throughput facility, home to custom-designed robotic systems, automated technologies, premier bench laboratory space and all the high-powered computing hardware and software necessary for processing petabytes of data.

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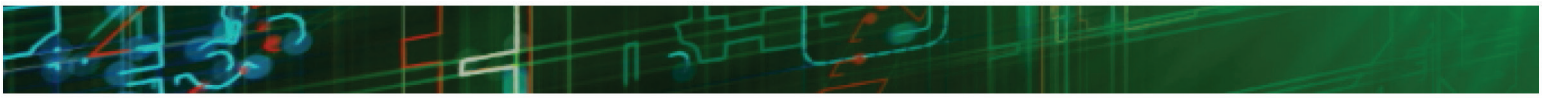

Bionics Institute

Primary Contact

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Capabilities

Medical device safety and efficacy testing (in vitro and in vivo)

- Design, rapid prototyping & validation testing
- Accelerated aging & flexion testing
- Electrochemical impedance spectroscopy
- Acute feasibility studies
- Chronic safety and biocompatibility studies
- Drug delivery techniques
- Histology & data analysis
- Scanning electron microscopy of implanted materials
- Preclinical animal model development

Custom device prototyping & fabrication

- Design and fabrication of custom electrode arrays and surgical tools
- Use of FDA approved materials

'First in human' clinical trials

Clinical and Scientific Track Record

- 35 years of internationally recognised experience & scientific excellence
- Extensive clinical, academic & commercial partnerships
- Proven research & clinical development pathways

Staff and Facilities

- Experienced and qualified scientists, engineers and clinicians
- Co-located in a major Australian hospital
- Purpose built equipment and facilities

Boston Micromachines Corp

Primary Contact

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About

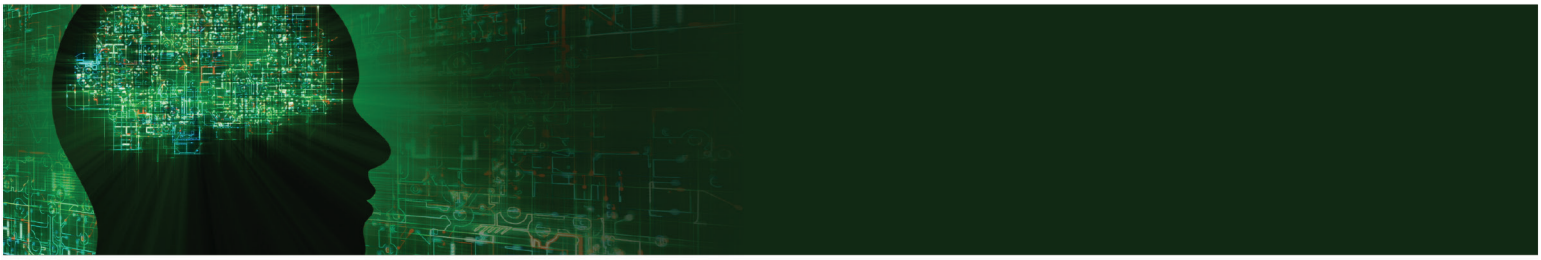
Boston Micromachines Corporation (BMC) is the leading provider of microelectromechanical systems (MEMS) deformable mirror products and has expertise in the design of adaptive optics systems. The company's suite of award-winning compact DM products is the most cost-effective, highest performance mirrors in the market today. By applying wavefront correction, BMC devices can be used in a variety of applications which include laser beam shaping, microscopy, astronomy, and vision science. Located in Cambridge, MA, BMC is privately held and offers custom-designed manufacturing services in addition to its portfolio of standard DM products and adaptive optics systems.

Capabilities

The specific capabilities/services the company provides in relation to the NESD falls into two categories:

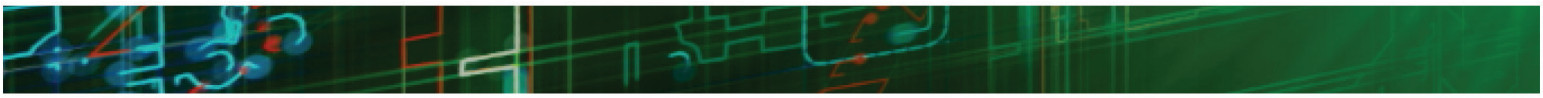
Deformable mirrors systems for use in neurological imaging instruments

- MEMS deformable mirrors ranging in size from 140 – 1000 actuators
- Mirror surface geometries of continuous, segmented, and hexagonal tip-tilt
- High speed drive electronics



These devices are currently being used in in vivo neural imaging systems at various premier research institutions around the country. Boston Micromachines also provides research and development services for advancing the deformable mirror and drive electronics technology and design to better fit specific applications.

- Advanced imaging systems utilizing adaptive optics to improve resolution and contrast in in vivo subsurface imaging application (i.e. deep penetration brain imaging)



Boston Scientific

Primary Contact

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Capabilities

- Lead prototyping
- Firmware modifications to the implantable pulse generators (IPG)
- Software modifications to the computer programmers (CP)
- Use of advanced computational models and predictive algorithms for parameters and programming guidance for neurostimulation

Additional Contacts

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Chronocam

Primary Contact

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Capabilities

- Extensive know-how in designing, developing and industrialising asynchronous, event-based, bio-inspired vision sensors
- Expertise in developing and customising event-based, bio-inspired computer vision algorithms for a large number of applications spanning from autonomous navigation, security and surveillance, aerospace and defence to biomedical devices and smart objects
- System integration capabilities: development of camera systems relying on Chronocam's proprietary vision sensors and development of embedded software porting Chronocam's proprietary computer vision algorithms on a large number of processing platforms (such as: CPUs, GPUs, FPGA)

Additional Contacts

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Cirtec

Primary Contact

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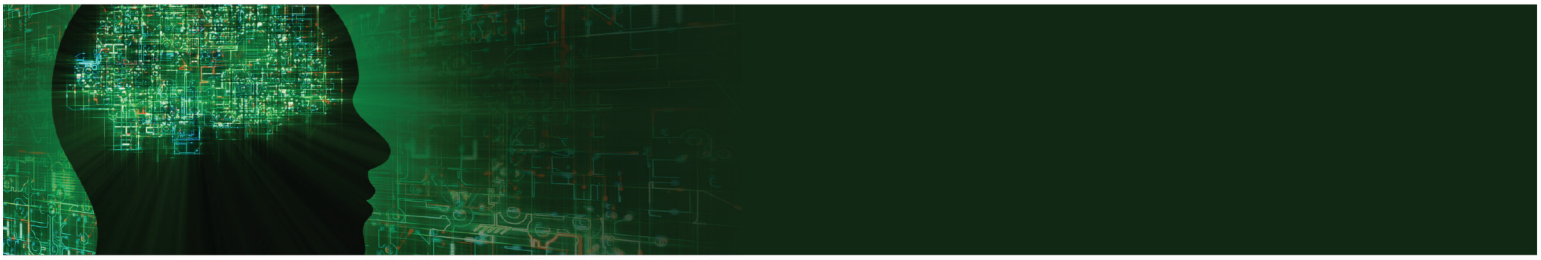
About Cirtec

Cirtec Medical has been providing contract design, development, and manufacturing services to the medical device industry since our founding in Massachusetts in 1986. Today, Cirtec has over 150 employees in our two facilities on the east and west coasts.

Cirtec has supported active implantable developers throughout our history. Early projects focused on hermetic welding and testing services for implantable neurostimulation devices, with service offerings expanding to provide full design and development. In all, Cirtec has worked with over 60 different companies and institutions developing active implantable devices, with over 30 in the neuromodulation space. We work with companies and institutions of all sizes, from early stage starts-ups to large, well-established medical device manufacturers. We also work frequently with research laboratories and academic groups; our current projects include development and manufacturing of an implantable neurostimulator used for research and recently approved for clinical study under a feasibility IDE.

Capabilities

Cirtec is ISO 13485 certified and FDA registered.
Cirtec supports the full product development cycle from conceptual development and requirements definition through clinical and commercial manufacturing.



Our engineering teams including mechanical, electrical, and software design resources as well as process development, manufacturing, and quality engineering. Cirtec has a robust and flexible quality system; start-up companies and research groups often choose to work under our quality system rather than developing their own. We provide design history file management and document control services. We can also perform or contribute to requirements documentation, risk management activities, and design verification activities. Our manufacturing capabilities relevant to active implantable devices include:

- Laser welding
- Resistance welding
- Electrical assembly
- Laser marking
- Laser ablation
- Surface treatment
- Ultrasonic cleaning
- Epoxy molding and adhesion
- Silicone molding and adhesion
- Packaging and labelin

Manufacturing capabilities are supported by in-house test capabilities. These include mechanical testing, hermetic leak testing, bench level and automated electrical testing, environmental conditioning, and custom test setups such as soak or pressure testing.

Our manufacturing infrastructure includes multiple ISO class 7 cleanrooms and ESD safe handling procedures for all devices. Cirtec provides complete supply chain management services, leveraging our extensive Approved Supplier List and robust inventory management and material traceability procedures.

VALUE TO PROPOSING TEAMS: There are six primary areas where Cirtec capabilities provide value to proposing teams.

Hermetic barrier development	Hermetic package and barrier design
	Leak specification development
	Internal moisture management: Vacuum bake, desiccant handling, residual gas analysis testing
	Hermetic sealing (welding, brazing) and testing
Electrical assembly	Soldering, wire bonding, and die bonding
	Coil winding
	ESD-safe workspaces
	Lithium battery safe handling procedures
	Bench and automated testing
Interconnect development	Feedthrough design and sourcing
	Hardwired and disconnectable design
	Fabrication and testing
Encapsulation	Epoxy, silicone, and parylene encapsulation
	Layered encapsulation design to manage fluid ingress
	In-house design, tooling, molding, testing
Sterile packaging	Package design
	Pouch and tray packaging and labeling
	Off-the-shelf double sterile tray system
	Sterilization service provider management
Quality system support	Design control support and design history file maintenance
	GMP manufacturing
	Supply chain management
	Procedures for and support of requirements definition, risk management, design verification, and process validation

Dragon ID

Primary Contact

Eugene Malinskiy / eugene@dragonid.com

Capabilities

- Our staff is very experienced working within the complexities of the medical system from observing physicians in the operating room to bringing devices through regulatory approval.
- We have engineers with process development and industrial experience, including interfacing directly with manufacturers.
- We have software engineers experienced in both hardware and software engineering and experience in microcode and embedded systems, end user applications, and high performance computing.
- In addition to engineering talent, we staff researchers, designers, and SMEs to bring a truly interdisciplinary approach to innovation and design for a project.
- We have experience recruiting, establishing, and coordinating relationships between global stakeholders for complex projects to maximize accountability and efficiency for a product while minimizing bureaucracy required.
- We work with our world--class partners in industries such as industrial design, rapid multi--material prototyping, materials selection, and manufacturing in order to round out our capabilities for a product.

Freedom Photonics LLC

Primary Contact

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About

Founded in 2005 we are privately held Limited Liability Company based in Santa Barbara, California with ISO Qualification in process, certification in Q2 2016. We develop, manufacture and market complete photonic integrated circuit based products (Indium Phosphide, PLC, Si Photonics).

Our main markets in components, modules and subsystems are for fiber-optic communication, free-Space-optical (FSO) communication and infrared sensors and illuminators.

Capabilities

We offer electronics design, assembly and testing with expertise in photonic design, packaging, control electronics, manufacturing and qualification.

We offer services across development and have a premier R&D compound semiconductor facility with lithography (steppers, DUV stepper, EBL), wet and dry etching, deposition and characterization capabilities.

Our Business Model

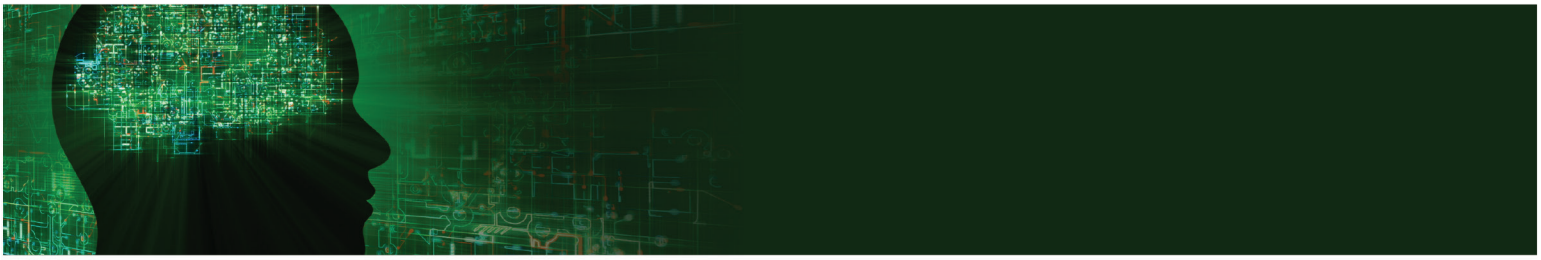
Conceptualization, prototyping and development

- Fast R&D turn-around and low cost device fabrication in Nanotech cleanroom facility (Freedom Photonics employees)
- Internal multi-project wafer runs

Volume device production with commercial foundries worldwide

- Fabrication processes designed for manufacturability
- Access to manufacturability and production capacity, qualified processes
- Experience in outsourcing volume device manufacturing

Significant internal capability for assembly, packaging, test



Capabilities and Facilities I – Photonics Design and Fabrication

Design

- Commercial and proprietary tools for passive and active PIC modeling, (Lumerical, native FDTD/BPM code, mode solvers, mask layout, SOA/active region models, Simwindows, SRIM)

Mask layout

- Proprietary scripting tool, with design rule checker and automated mask plate layout

Fabrication

- Full wafer process, die pick-and-place, wedge bonder, ball- bonder, auto-cleaver, pull-tester, etc.

Capabilities and Facilities II – Photonics Production Test

- Photonic device bar level probe
- Chip-on-carrier level (probe card)
- Package; DC, spectral, and data testing
- Burn in – monitored, environmental chambers

Capabilities & Facilities III – Packaging

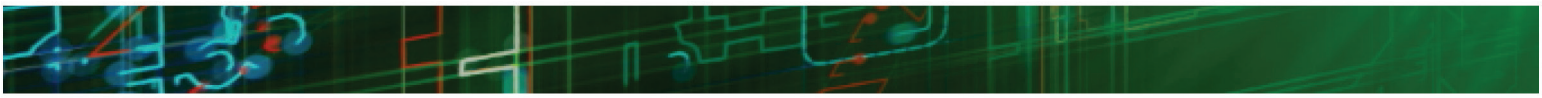
Several in-house systems with laser welding and UV curing capability.

- Custom tooling, TOSA packages, 14 pin butterflies etc.
- ZEMAX commercial optical train design tool

Capabilities and Facilities IV – Electronics

- Digital and Analog Electronics
- FPGA design and verification tools in house
- Commercial tools for board layout
- Outside foundry for PCB fabrication and stuffing
- Electronics workstations for assembly and test
- Oscilloscopes, sources, multi-meters

We perform contract fabrication and engage with a number of domestic and international fabrication providers, both full process or selected fabrication steps are available.



IMEC

Primary Contact

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Capabilities

IMEC is interested in making its comprehensive capabilities available for joint-research programs for solutions in Life Sciences Technologies, Healthcare and Bio-medical engineering, including:

- Semiconductor/nanotechnology
- Process technology
- Design technology and systems/software technologies

Additional Contacts

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Infinite Arthroscopy

Primary Contact

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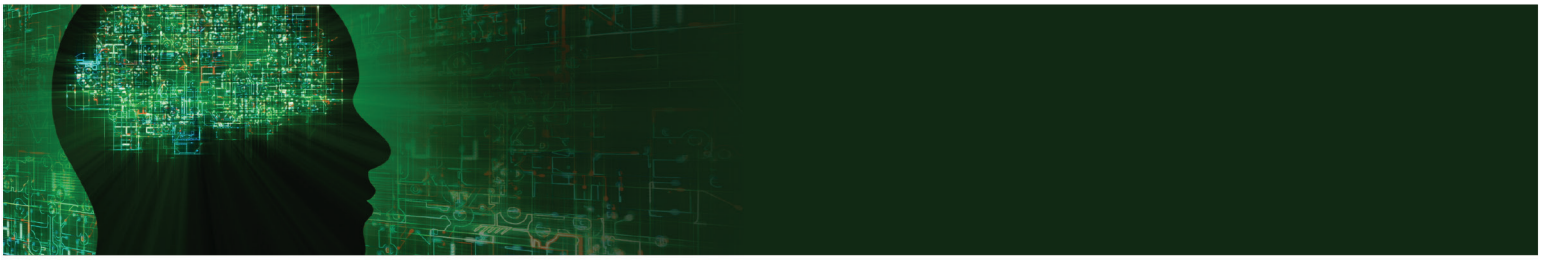
About

We are exclusively focused on developing new medical technologies with an emphasis on translating innovations from other industries to the operating theatre. We have experience in the full life cycle of medical device development from initial conception to regulatory submission. We have large number of rapid prototyping and fabrication techniques available in-house including but not limited to software-based design, stereolithography, fused deposition modelling, PCB milling, and machining. Our staff includes designers, engineers, health care professionals, and subject matter experts from a diversity of industries allowing us to leverage a far wider knowledge base than the standard medical device company. We maintain a nationwide network of leading physicians and institutional partners to develop, refine, and validate our technologies according to contemporary healthcare practice and needs.

Capabilities

Infinite Arthroscopy also maintains a portfolio of intellectual property derived from our medical device technologies that would be available to the NESD Industry Group. Two relevant examples are listed below.



Infinite Arthroscopy, Inc. Proprietary Technologies:
Novel Light Source

- Miniaturized / Ruggedized
- Low power (sub 1 watt)
- Low heat (to LEDs of comparable lumen-output)
- High lumen output
- Long Lifetime (50,000+ hours)
- Emits only target wavelength(s) (Capacity to customize to project needs)

Command/Control Architecture for Medical Devices

- HIPAA/FTC Approved for use in Operating Rooms
- Uninterrupted High-bandwidth capacity
- Transmission below standard RF noise floor
- Encrypted protocol

Additional Contacts

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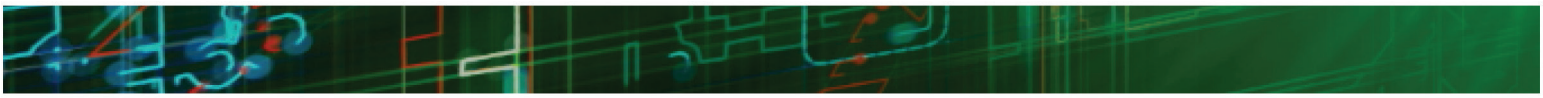

Inscopix

Primary Contact

Pushkar Joshi / pushkar@inscopix.com

Capabilities

- Neuroscience application development and validation (surgical procedures for rodents and non-human primates, application of biological reagents within our own life science lab)
- Optical system development (lens design and simulation, LED light source development, prototyping)
- Hardware system (FPGA-based and/or microcontroller based mixed-signal systems especially involving imaging, mechanical packaging) development, testing, and prototyping
- Software (application, image processing, computer vision, analytical) development and testing
- Mechanical accessories development (design, prototyping via 3D printing)
- With these capabilities, we can customize Inscopix's existing and emerging systems and applications, or develop new systems and applications for or with other proposers in support of this program.

Additional Contacts

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Nanomedical Diagnostics

Primary Contact

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Capabilities

- Graphene FET sensor array chips appropriate for integration with nearly any biochemical or electrochemical interaction
- Current sensor hardware capable of measuring biochemical and bioelectric interactions over time with 10 millisecond time resolution, and spatial resolution less than 10 microns
- Capability to produce sensor hardware with time resolution approaching one microsecond with a spatial resolution less than 2 microns
- Expertise in combining electronic materials, packaging and assembly with active biological materials
- Projected FDA clearance for an in vitro clinical product, and associated manufacturing chain, using graphene sensors by mid 2017
- Graphene appropriate for use in medical sensors integrated into an electronic or implantable platform of your choosing
- Chemical and biochemical expertise in biochemical attachment and blocking techniques specialized for boosting specificity of electronic readout of biological interactions
- A complete "turnkey" R&D system for using graphene sensor chips
- Hardware and software appropriate for reading graphene biosensors

Additional Contacts

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Naval Research Laboratory

Primary Contact

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About

NRL is the corporate research laboratory for the Navy and Marine Corps and conducts a broad program of scientific research, technology and advanced development.

The Optical Materials and Devices Branch has five primary areas: high purity chemicals, specialty optical materials, silica fiber technology, optical devices and advanced concepts.

Capabilities

We have expertise in the research, development and fabrication of glasses, glass-ceramics, ceramics, crystals, bulk optics, films, waveguides and optical fibers.

We offer a full suite of capabilities to make transparent ceramics to solve the ceramic packaging needs of NESD, some key properties:

- UV to RF transparency tailoring
- Tougher, stronger, harder than glass
- Electrically inert
- Demonstrated conformal shapes
- Demonstrated bonding technologies
- Vertical integration

Our facilities include class 100 clean rooms, powder processing equipment, sintering systems, and characterization capabilities (XRD, SEM, TEM, optics labs, mechanical testing).

Some of our prior applications include: Conformal Optics, IR simulators, photonic mast design, flexible PV's, IRCM, and Directed Energy Weapons.

Additional Contacts

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Star Lab

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About

Star Lab is a high-tech small business focused on complex systems security research and development, with significant expertise and a pedigree of success developing security technologies for safety-critical and mission-critical systems. The company specializes in the areas of high-assurance operating systems, technology protection, applied cryptography, and anti-tamper, and is also a leader in kernel/hypervisor/embedded software development. Star Lab has offices in Washington D.C. and Huntsville, AL.

Additional Contacts

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Qualcomm

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Capabilities

- Experience in building an end-to-end platform as a reference design for interface with brain
- Experience in driving an industry wide standard effort to standardize a communication medium and protocol for brain interface
- Advanced low power wireless solutions, RF interface, MODEM system solutions and related electronics for brain interface
- Advanced wireless charging and powering solutions for brain implants
- Ultra low power electronic design solutions at advanced technology nodes suitable for brain implants to enable always on monitoring and processing
- Ultra low power DSP solutions, stream data processing and data compression and decompression solutions

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