

Special Notice 12-SN-0027
Special Program Announcement for 2012 Office of Naval Research
Research Opportunity:
Synthetic Biology Tools for Sensing and Bioprocessing

I. INTRODUCTION:

This announcement describes a research thrust, entitled “Synthetic Biology Tools for Sensing and Bioprocessing” to be launched under the ONR BAA12-001 / 13-001, Long Range Broad Agency Announcement for Navy and Marine Corps Science and Technology which can be found at <http://www.onr.navy.mil/Contracts-Grants/Funding-Opportunities/Broad-Agency-Announcements.aspx>. The research opportunity described in this announcement specifically falls under numbered paragraph 2 (item”1q”) of the sub-section entitled Warfighter Performance, Human and Bioengineered Systems. The submission of proposals, their evaluation and the placement of research grants and contracts will be carried out as described in that Broad Agency Announcement.

The purpose of this announcement is to focus attention of the scientific community on (1) the areas to be studied, and (2), the planned timetable for the submission of white papers and proposals.

II. TOPIC DESCRIPTION:

The proposed topic will lead to transformational, synthetic biology approaches for (1) agile and organic sense-and-respond capabilities, and (2) novel, ‘electrosynthetic’ production of fuels or other high value materials. The program will pursue several challenging issues that are critical to developing practical synthetic biology systems for these and other naval applications:

- Development of high-throughput methods to assess function of designed genetic circuits in cellular context, to uncover new metabolic pathways, or novel sensing modalities.
- Improving information exchange between cells
- Understanding how electrical current can serve as a direct electron donor into cells/multicellular systems

Background:

Synthetic Biology is a relatively new field which brings together concepts drawn from electrical engineering, molecular and cellular biology, and biocomputation. This field is intended to serve two purposes: (1) to allow the design and engineering of organisms that possess a specific, reproducible function from a set of validated genetic parts, circuits and chassis organisms, and, (2) to allow the systematic study of the structure and function of genetic components in natural cellular/multi-cellular systems.

The Office of Naval Research has been funding basic and applied research in Synthetic Biology for the past several years, with several applications or new naval capabilities as the anticipated endpoint of this research program:

- Secure, renewable, scalable production of energy, fuels or high-value naval materials – potentially in remote, resource-limited locations
- Stealthy, remotely-observable sentinel species for threat monitoring and response to these threats (e.g., explosives)
- Autonomous, living-non-living hybrid robotic systems that utilize cells as environmental sensing and information processing components
- Utilizing synthetic biology to effect inorganic materials fabrication across multiple length scales.

Although the appeal of Synthetic Biology is high, the implementation of this approach is not as straightforward, nor as reliable as its electrical engineering analog, in part due to inherent complexity and dynamic conditions in living cells. Despite the growing number of ‘tested’ genetic parts, circuits and chassis organisms that are available, combining these in anticipation of fabricating a biosensor or bioprocessing system that functions predictably still requires substantial experimentation, and often results in failure. It is not unusual for these engineered cells/systems to grow poorly, or to succumb to toxicity of products they’re being asked to produce or in the presence of signals they’re being asked to detect. Although *E. coli* is a favored bacterial chassis for synthetic biology studies, it is perhaps not the most useful organism for the applications ONR is interested in, for these reasons.

Significant gaps exist in our ability to design and test integrated sense-and-respond circuits, or metabolic synthesis circuits, in a rapid, high-throughput manner, particularly in environmentally robust cells or multi-cellular organisms. ONR has started to explore robust environmental microbes as potential chassis, such as *Shewanella* and *Geobacter*, which are tolerant of many chemicals as well as able to respire on inorganic substrates and produce electrical current when grown on electrodes. ONR has also started to investigate the utility of new, non-diffusion-limited signaling modes between cells (or cells and other devices) such as light, magnetic fields, or electric current, as these may prove useful in sense-and-respond systems.

For bioprocessing applications such as the production of fuels or materials, Synthetic Biology offers great promise for increased efficiency, potential for design of cellular ‘chemostats’, and utilization of varied and sustainable starting materials under possibly harsh conditions. Significant and exciting accomplishments have been noted with systems engineered to utilize waste organic matter, CO₂, photosynthesis, or ‘electrosynthesis’ to produce fuel, electricity or other organic compounds, although the spectrum of products that have been synthesized to date are rather limited. What is needed is improved understanding of both the mechanisms by which cells/organisms can utilize interesting substrates (e.g., CO₂, electrons) to produce more complex organic or inorganic materials, as well as genetic tools to efficiently modify naturally-occurring lithotrophic organisms that have evolved to do so.

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Objectives:

The Office of Naval Research (ONR) is interested in receiving proposals in the following specific areas. Proposals that address more than one of these areas are desirable but not required.

- Develop rapid, generalizable methods for designing/testing *integrated* sensing and actuation components in a cellular/multi-cellular context. Approaches should consider the use of both chemical and non-chemical signals for detection and response.
- Enabling high information content communication between cells, or between cells and non-living components, possibly utilizing non-natural transduction modes and electronic coupling. Detection and/or production of chemical or non-chemical signals such as electrical current or fields, magnetic fields, mechanical forces, or specific wavelengths of light should be considered.
- Design and test feasibility of using environmentally robust, genetically tractable, ‘chassis’ organisms, including novel microbes and multi-cellular eukaryotes.
- Develop microbial/multi-cellular catalysts that can utilize electrical current directly as an electron donor, and elucidate mechanisms of electron transport into these catalysts and their metabolic pathways
- Identify high-throughput methods for discovery of unusual microbial metabolism/pathways, and screening for new genetic systems and/or engineered systems that can lead to efficient production of fuels or other organic/inorganic compounds in remote locations.

III. WHITE PAPER SUBMISSION

White papers should not exceed 4 single-sided pages, exclusive of cover page and resume of principal investigator, and should be in 12-point Times New Roman font, single-spaced, with margins not less than one inch. The cover page should be labeled “White Paper for ONR 2012 Research Opportunity: ‘Synthetic Biology Tools for Sensing and Bioprocessing’ and include the following information: title of the proposed effort, technical point of contact, telephone number, fax numbers, and e-mail address. The 4-page body of the white paper should include the following information: (1) Principal Investigator; (2) Relevance of the proposed effort to the research areas described in Section II; (3) Technical objective of the proposed effort; (4) Technical approach that will be pursued to meet the objective; (5) A summary of recent relevant technical breakthroughs; and (6) A funding plan showing requested funding per fiscal year. A resume of the principal investigator, not to exceed 1 page, should also be included after the 4-page body of the white paper.

Each white paper will be evaluated by the Government to determine whether the technology advancement proposed appears to be of particular value to the Department of the Navy. Initial Government evaluations and feedback will be issued via e-mail notification from the Technical Point of Contact. The initial white paper appraisal is intended to give entities a sense of whether their concepts are likely to be funded.

Detailed Full Proposal will be subsequently encouraged from those Offerors whose proposed technologies have been identified through the above referenced e-mail as being of “particular value” to the Government. However, any such encouragement does not assure a subsequent award. Full Proposals may also be submitted by any offeror whose white paper was not identified as being of particular value to the Government.

For white papers that propose efforts that are considered of particular value to the Navy but either exceed available budgets or contain certain tasks or applications that are not desired by the Navy, ONR may suggest a full proposal with reduced effort to fit within expected available budgets or an effort that refocuses the tasks or application of the technology to maximize the benefit to the Navy.

White papers should be submitted electronically to the program technical points of contact, Dr. Linda A. Chrisey, linda.chrisey@navy.mil. These white papers shall be in Microsoft Word or Adobe PDF format.

To ensure full, timely consideration for funding, white papers should be submitted **no later than October 5, 2012**. White papers received after that date will be considered as time and availability of funding permit.

The planned date for completing the review of white papers is **October 19, 2012**.

V. FULL PROPOSAL SUBMISSION AND AWARD INFORMATION

Full proposals should be submitted under **ONR BAA 13-001** by **December 10, 2012**. Full Proposals received after that date will be considered as time and availability of funding permit.

ONR anticipates that primarily grants will be issued for this effort, although contracts may be considered as well. Full proposals for grants should be submitted in accordance with the instructions at Section IV, Application and Submission Information, item 5, Submission of Grant Proposals through Grants.gov. All full proposals for grants must be submitted through www.grants.gov. The following information must be completed as follows in the SF 424 to ensure that the application is directed to the correct individual for review: Block 4a, Federal Identifier: Enter N00014; Block 4b, Agency Routing Number, Enter the three (3) digit Program Office Code **342** and the Program Officer’s name, last name first, in brackets (“**Chrisey, Linda A.**”). All attachments to the application should also include this identifier to ensure the proposal and its attachments are received by the appropriate Program Office.

Full proposals for contracts should be submitted in accordance with the instructions at Section IV, Application and Submission Information, item 2.b, Full Proposals.

Budgets should be constructed with funding periods that align with the Government fiscal year as follows:

- Period 1: 2/15/2013 - 9/30/2013
- Period 2: 10/1/2013 - 9/30/2014
- Period 3: 10/1/2014 - 9/30/2015
- Period 4: 10/1/2015 – 2/14/2016

ONR plans to fund **five to ten individual or team awards** with a value of \$200,000-\$400,000 (direct + indirect costs) per year, using basic and applied research funds. However, lower and higher cost proposals will be considered. The period of performance for projects may be from 2-4 years.

Although ONR expects the above described program plan to be executed, ONR reserves the right to make changes.

Funding decisions should be made by **January 8, 2013**. Selected projects will have an estimated award date of **February 15, 2013 for grants and May 31, 2013 for contracts**.

VI. SIGNIFICANT DATES

Event	Date
White Paper Submission Date	October 5, 2012
Notification of White Paper evaluation*	October 19, 2012
Recommended Full Proposal Submission	December 10, 2012
Notification of Selection: Full Proposals *	January 8, 2013
Awards *	Grants - February 15, 2013 Contracts- May 31, 2013

Note: * These are approximate dates.

VII. POINTS OF CONTACT

In addition to the points of contact listed in ONR BAA12-001 / 13-001, the specific points of contact for this announcement are listed below:

Technical Points of Contact:

Dr. Linda A. Chrisey, Program Officer for Naval Biosciences and BiocentricTechnology,
linda.chrisey@navy.mil, 703-696-4504

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Business Point of Contact:

Richard H. Pollack, ONR Contract & Grant Awards Management Division, Code 254,
richard.pollack@navy.mil, 703 588-2837

VIII. Submission of Questions

Any questions regarding this announcement must be provided to the Technical Points of Contact and/or the Business Point of Contact listed above. All questions shall be submitted in writing by electronic mail.

Answers to questions submitted in response to this Special Notice will be addressed in the form of an Amendment and will be posted to the following web pages:

- Federal Business Opportunities (FEDBIZOPPS) Webpage – <https://www.fbo.gov/>
- Grants.gov Webpage – <http://www.grants.gov/>
- ONR Special Notice Webpage - <http://www.onr.navy.mil/Contracts-Grants/Funding-Opportunities/Special-Notices.aspx>

Questions regarding **White Papers or Full Proposals** should be submitted NLT two weeks before the dates recommended for receipt of White Papers and/or Full Proposals. Questions after this date may not be answered.