Amendment Number 0001

Broad Agency Announcement 10-013

"Basic Research Challenge"

The purpose of Amendment Number 0001 is to revise the due date for full proposals and to incorporate the document entitled, "Biologically Inspired Intelligent Metamaterials" as attachment number 1 as follows:

1. Paragraph number 5 entitled, "Response Date" is deleted in its entirety and revised to read as follows

5. Response Date –
   A) White Paper Due Date: 03 July 2010
   B) Full Proposal Due Date: 19 July 2010

2. Section IV entitled, "Application and Submission Information" paragraph number 3 entitled, "Significant Dates and Times" is hereby deleted in its entirety and revised to read as follows:

3. Significant Dates and Times –

Anticipated Schedule of Events		
Event	Date	Time (EASTERN TIME)
FY10 White Papers Due Date	03 June 2010	4:00 PM
Notification of Initial Navy Evaluations of FY10 White Papers	17 June 2010*	
Full FY10 Proposal Due Date	**19 July 2010**	**2:00 PM**
Notification of Selection for FY10 Award	04 August 2010*	
Issued FY10 Awards	01 Sep, 2010*	

*These dates are estimates as of the date of this announcement.

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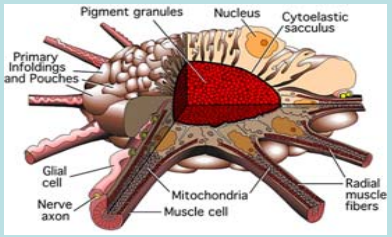
3. Section VII entitled, "Other Information" paragraph number 8 entitled, "Other Guidance, Instructions and Information" is hereby deleted in its entirety and revised to read as follows:

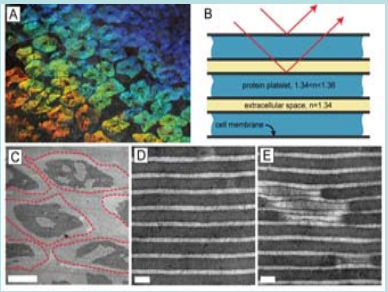
8. Other Guidance, Instructions, and Information

1. Attachment number 1 entitled, "Biologically Inspired Intelligent Metamaterials" – 10 pages.

Biologically Inspired Intelligent Metamaterials

Biology





Adapt to Environment

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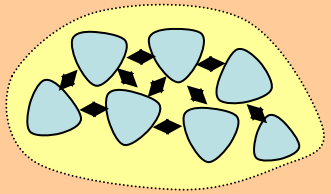
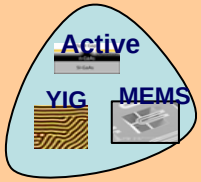
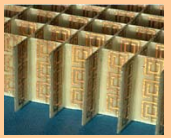
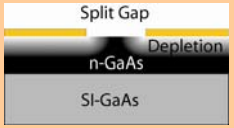
Man Made









Dr. Dan Purdy (Code 312)
Dr. Steven Ackleson (Code 322)
Dr. Mark Spector (Code 331)

Notional Concepts

- The following charts are ONLY intended to articulate notional ideas for biological inspired intelligent metamterials.

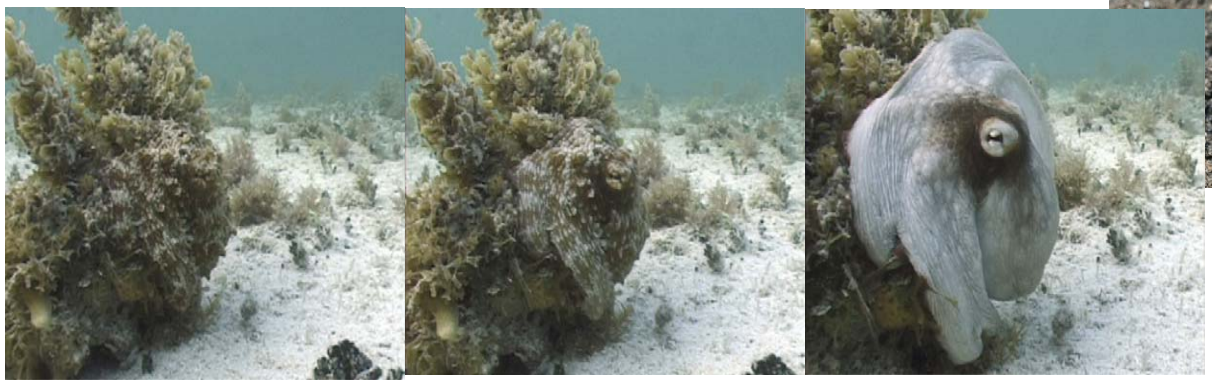
- Offerors are not limited to these notional concepts and should consider ideas and approaches as well.

To survive, biological systems must:

- sense and hide in clutter
- adapt in dynamic environment
- communicate covertly

Mantis Shrimp

Cephalopod



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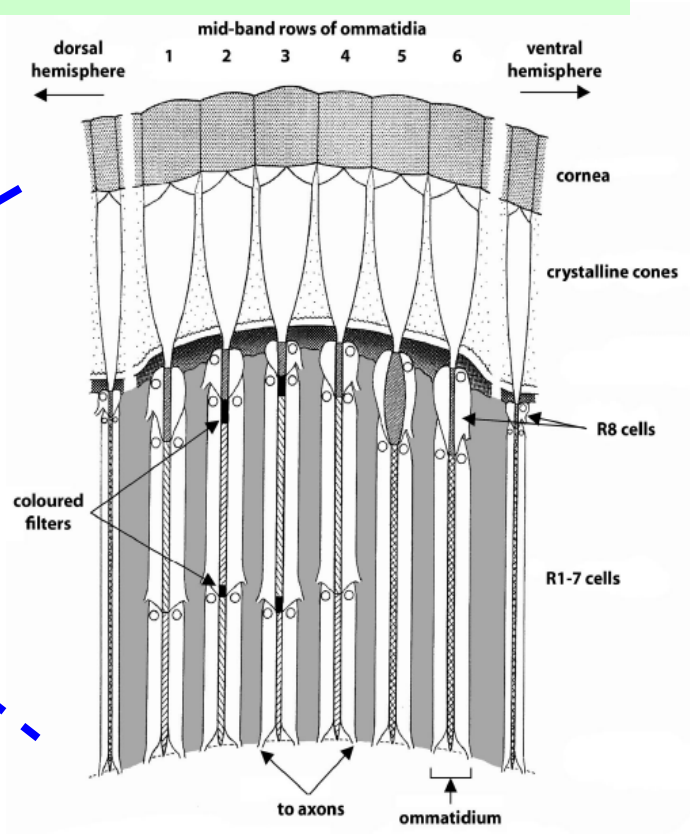
Insight: Does biology teach us a more elegant method of manipulating EM Fields to adapt to the environment

Mantis Shrimp "Communicate Covertly"

Mantis Shrimp eye:

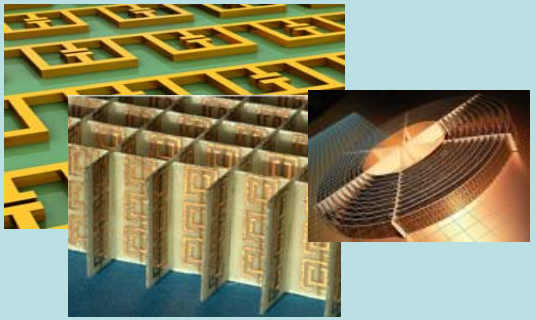
One of the most complicated, capable EM sensing organ in nature



Basic Research Challenge Goal

Metamaterials (Prior Art)

- Artificial engineered composites
- manipulate electromagnetic fields
- Fundamental limitations include limited bandwidth, high losses, lack of arbitrary polarization.



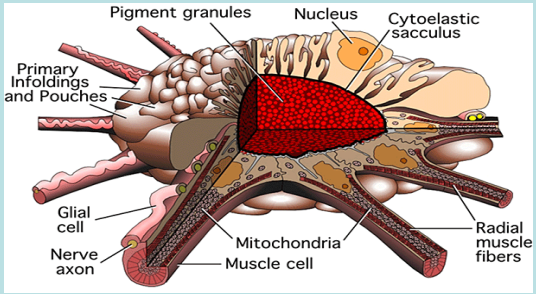
Intelligent Metamaterials (Novel – This BRC)

- Dynamic, sense and adaptive properties
- ***React*** to the electromagnetic environment

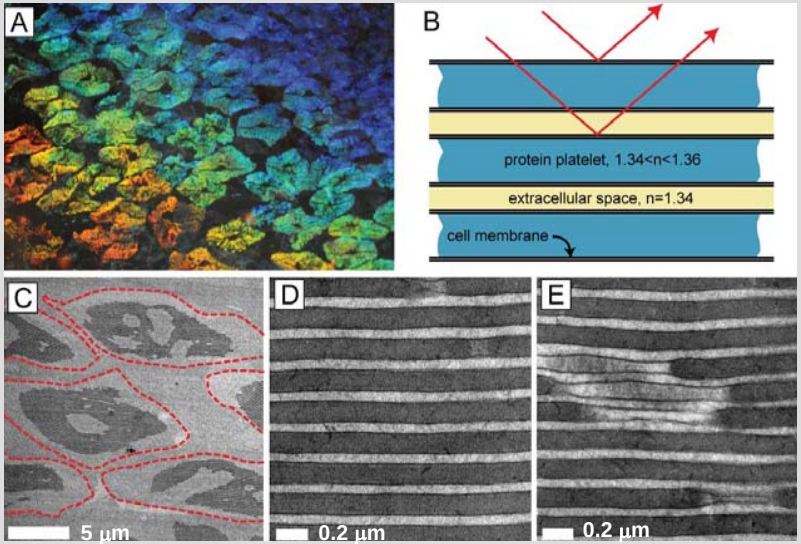
To explore concepts for *intelligent metamaterials* (IMM), inspired by examples in the marine environment, capable of sensing and reacting to a dynamic EM environment.

Biological Inspiration for Design of Intelligent Metamaterials

Biological Models



The cephalopod chromatophore has a central dye sack that can be expanded or contracted by radial mussels, creating more or less color.



A) Darkfield microscope image of iridophore cells; B) Illustration of intercellular Bragg reflector; C - E) TEM images of ultrathin cross-sections of iridophore cells.

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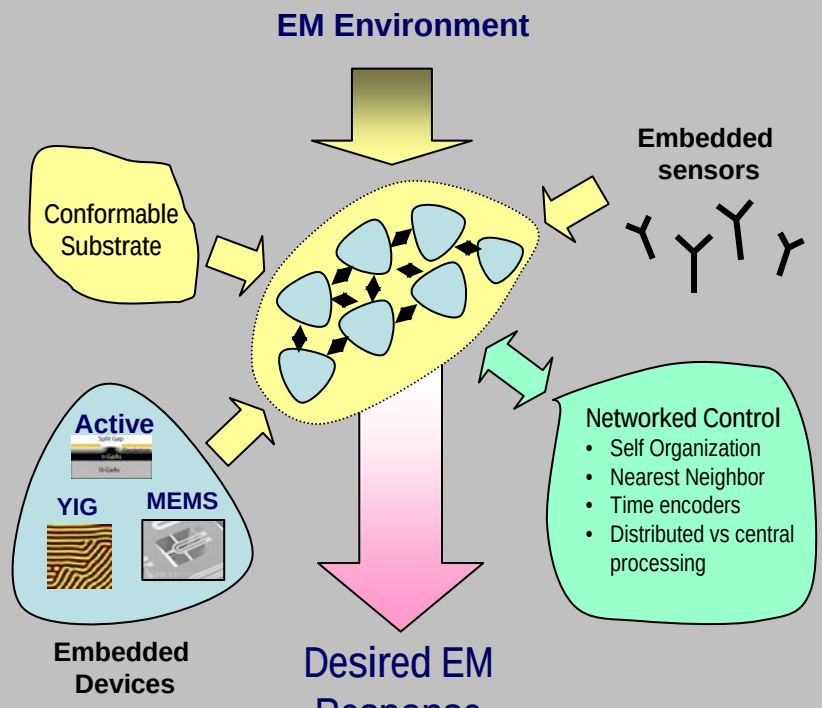
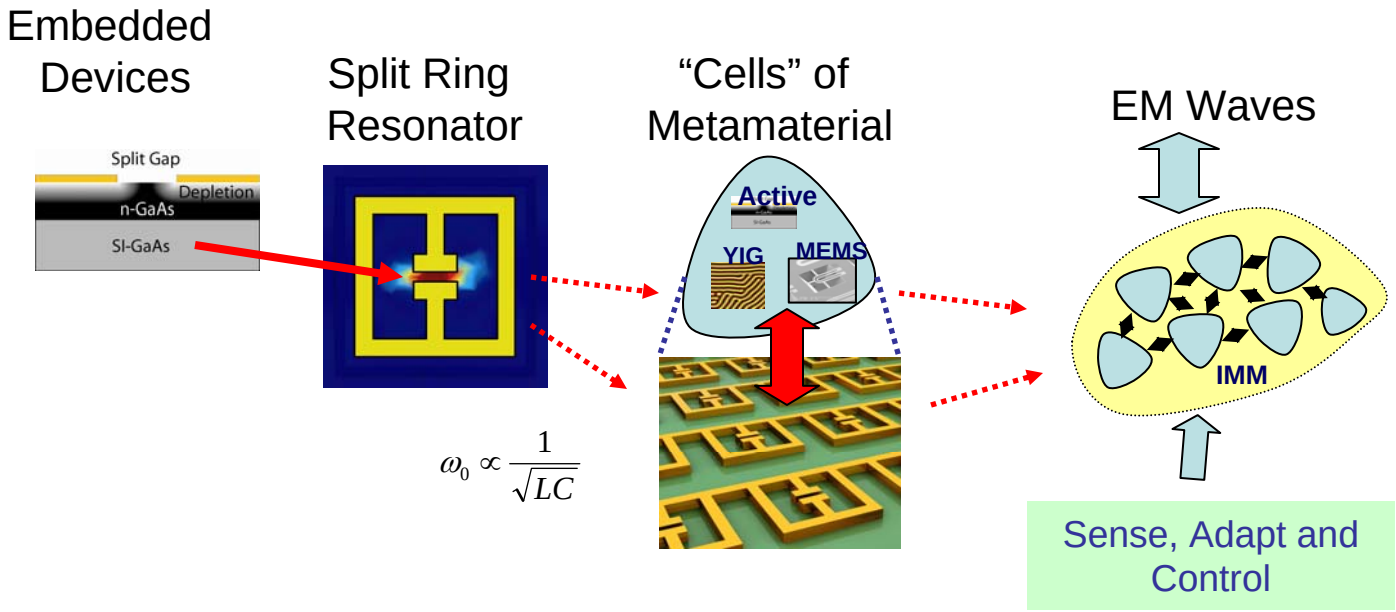
Intelligent Metamaterial (IMM)



Notional only

Notional Idea:

Embedding Active Metamaterials

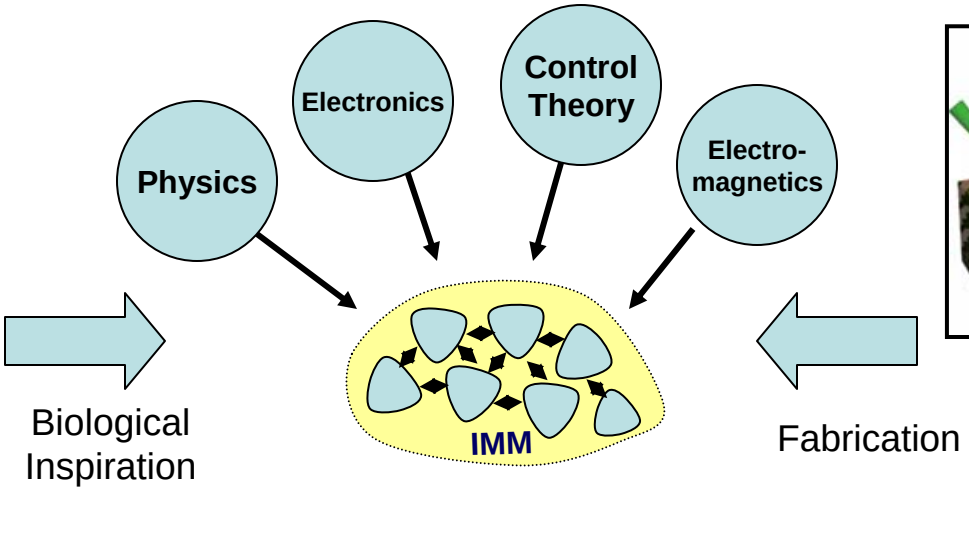


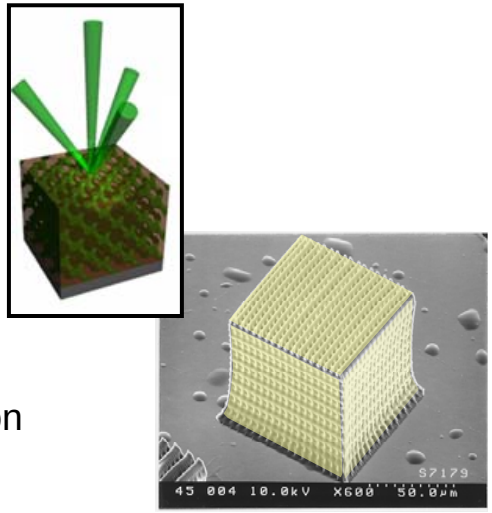
What if we added Sense, Adapt and Control?

- Intelligent control knobs? Networked control?
- New multi-dimensional signal processing techniques?
- Tunability? Gain? Encoders? Decoders? Modulators?
- Environmental sensing and response?

Objectives

- Explore how examples found in nature can lead to intelligent metamaterials (sense, control and adapt to environment)
- Investigate concepts of multidimensional sensing and signal processing
- Understand fundamental sense and control stability issues associated with central vs distributed vs networked concepts
- Determine fundamental strategies for manipulation of the EM response via intelligent metamaterials





Risks and Challenges

- How do the biochemical systems translate into an analogous electronic counterpart?
- What are optimal sensors, control architectures and conditions for stability?
- Are control functions handled via centralized or localized control architecture?
- Is it possible to harvest ambient energy to better function in the environment?

References: (optional)

[1] Cephalopod …

[2] mantis shrimp …