



**THE OHIO STATE UNIVERSITY**

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# **Integration of Breast Reconstruction with Cancer Diagnosis and Treatment by Nanomedicine**

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and

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## Breast Cancer is Diagnosed in over 200,000 American Women Each Year

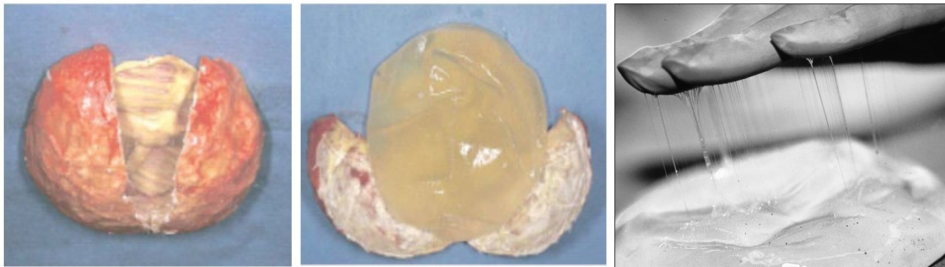
- Breast cancer claims >40,000 American lives each year
- Mastectomy with postoperative chemotherapy offers the best rate of survival
- Current tissue expanders and implants for reconstruction are silicone rubber-based that contains potentially harmful chemicals and cause inflammatory reactions
- 19% of post-mastectomy patients are currently subjected to recurrent cancer (2-3 years average)



## Reconstruction

### Silicone Rubber is Permeable, Prone to Rupture and often Elicits an Inflammatory Response

- With current breast implants: 35-50% of breast reconstruction patients require revisional surgery within 6 years



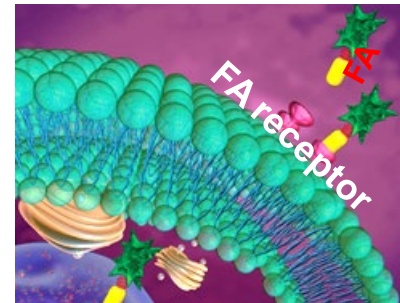
**Capsular Contracture:** A thick fibrous capsule forms around some implants leading to pain and disfigurement

## Chemotherapy

IV or oral – attacks all cells, causing side effects (hair loss, nausea, etc.)

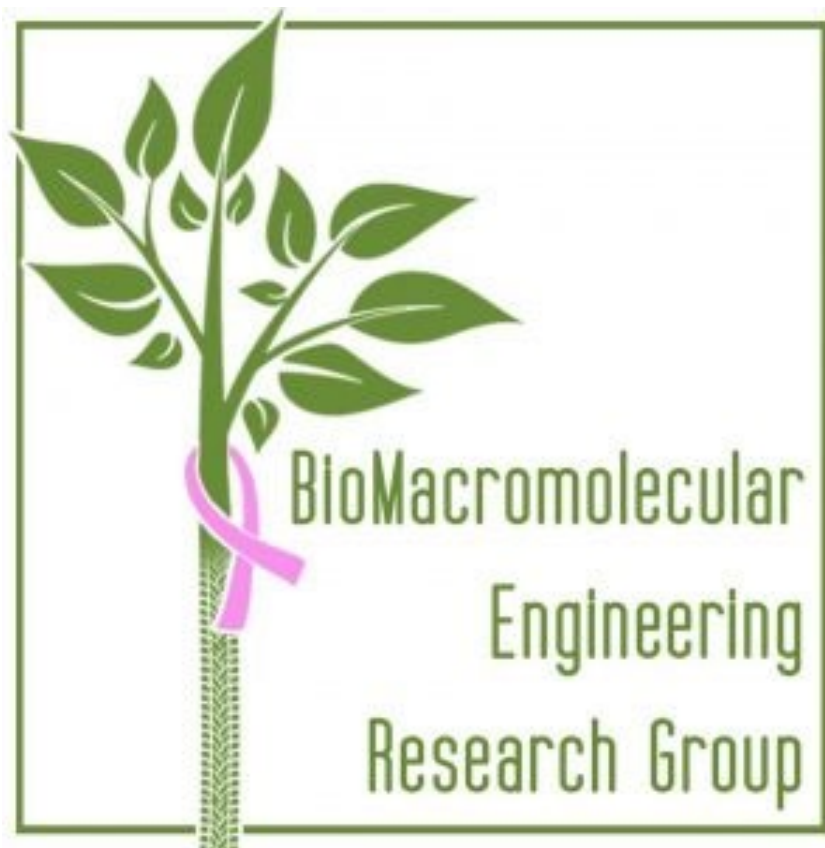
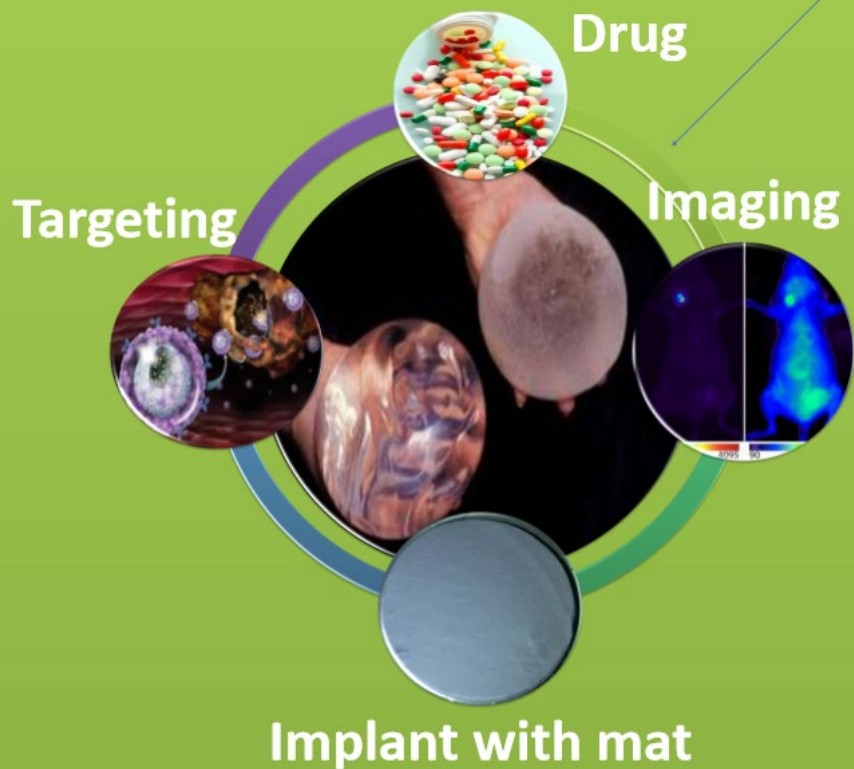
**Targeted Chemotherapy**  
**Only cancer cells**

**Still experimental, did not live up to promise**





# Polymer-based Integration of Breast Cancer Imaging/Treatment with Reconstruction





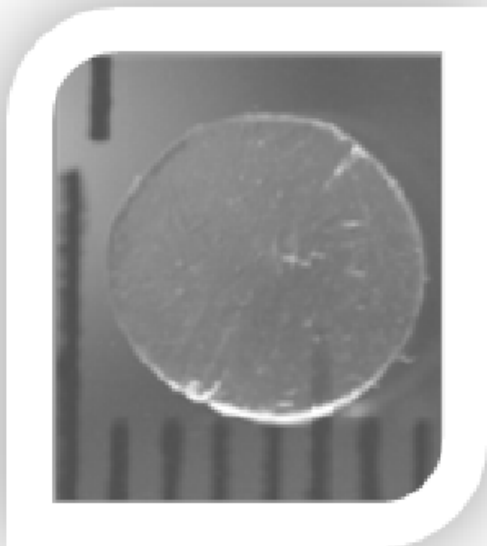
## Winners of the GE Healthymagination Challenge

- Launched by GE in September 2011 to identify and accelerate ideas to advance breast cancer early detection and diagnostics to help save lives
- GE healthymagination Challenge promised a \$100 million open innovation challenge help to identify and bring to market ideas that advance breast cancer diagnostics and treatment.
- More than 500 proposals from 40 countries were submitted in response to the “GE Healthymagination Cancer Challenge”
- GE awarded \$100,000 to each of five, breakthrough research ideas, including ours then disappeared





## Allomatrix™: A Novel, High Performance Biomaterial



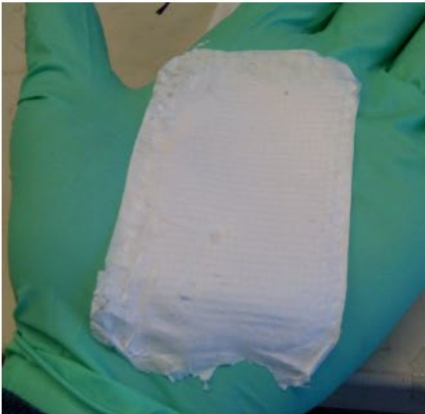
- Chemically and biologically stable
- Biocompatible
- Softer with better fatigue properties
- Impermeable to gases and liquids
- Self-sealing
- Reduced inflammatory response
- Thermoplastic rubber; no chemical additive

The first polymer Puskas coinvented serves as the drug-eluting coating on the Taxus coronary stent that has been implanted into > 6 million patients

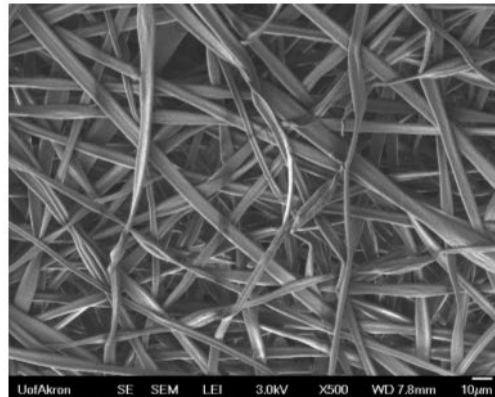


## Allomatrix™ Self-Supported Fiber Mats Provide Textured Vehicle for Local Drug Delivery

Electrospun Allomatrix™ fiber mat



Implant covered with mat



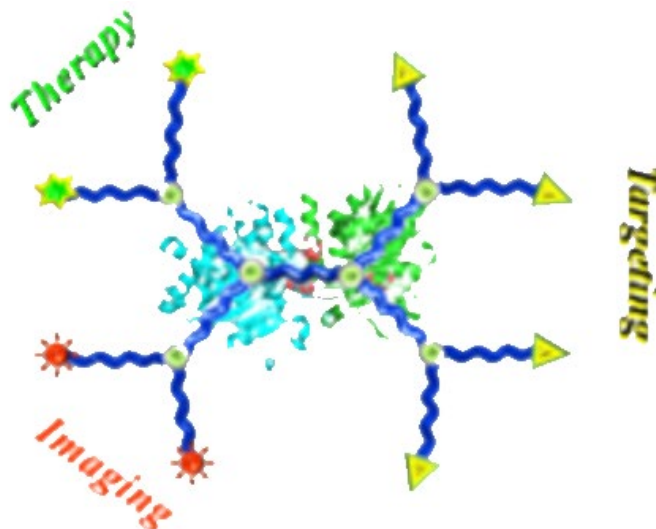
Encapsulation of traditional and nanomedicine for a slow, sustained local release:  
Cancer diagnosis and treatment



## Multifunctional Nanodevices

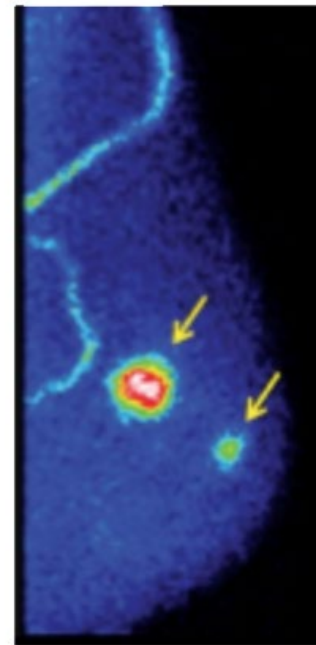
- Lower doses in chemotherapy
- Less/no side effects (hair loss, nausea)
- Imaging stray cancer cells

### Folate-targeted Polymer-Drug



Endozyme™

enzyme-catalyzed synthesis



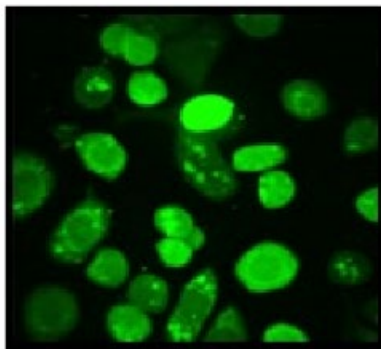




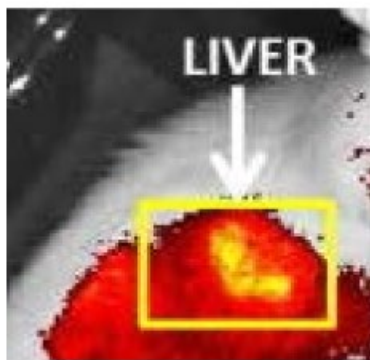
## Recent Results



Fluorescein imaging

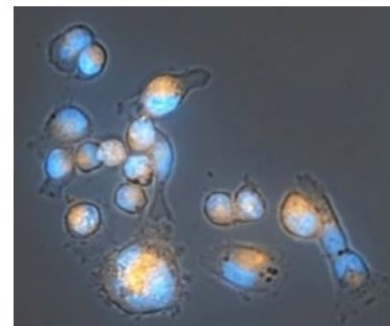


Delivery inside breast cancer cells



Rat liver tumor diagnosis

Drug delivery inside breast cancer cells



Blue: nuclei    Orange: Doxorubicin



## The Allomatrix/EndozymeDrug Delivery Platform Can be Expanded for a Range of Application

- Needs: establish GMP manufacturing of Allomatrix™ and Endozyme™ and to move to pilot scale production
- Technology can be expanded to allow for implantable devices with Antimicrobials, Anti-inflammatory agents, Steroids, Analgesics
- Aim to improve the efficacy of current biomedical devices by providing an improved biomaterial with pharmaceutical capabilities and to allow for the development of novel device technologies
- Medical Device Development: Ongoing collaboration with the Cleveland Clinic and the Semmelweis Medical University (Hungary)



**Cleveland Clinic**



