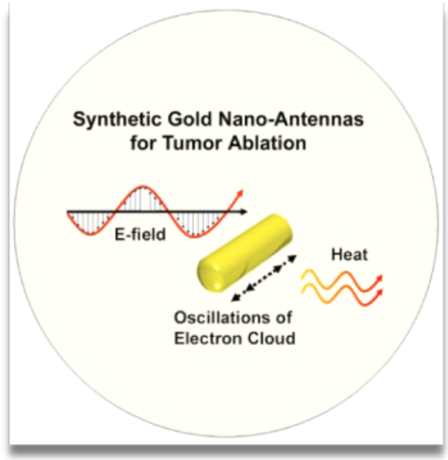
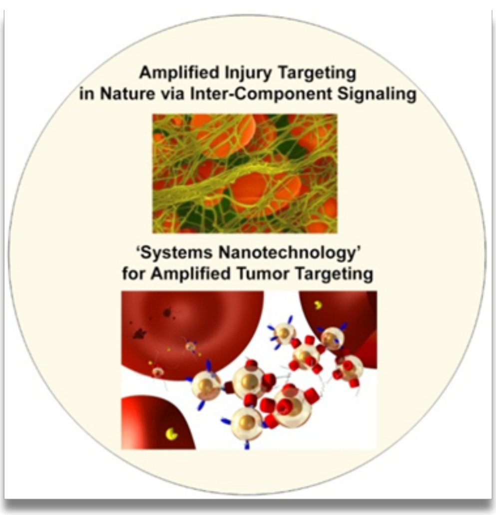
**2009 Winner of the $30,000 Lemelson-MIT Student Prize**
***Geoffrey von Maltzahn: Notable Inventions***

**Polymer-Coated Gold Nano-Antennas for Cancer Ablation**




Building on recent innovations in inorganic nanoparticle synthesis, Von Maltzahn developed polymer-coated gold nano-antennas, or nanoparticles, that mediate tumor destruction by targeting cancerous cells and potently transducing benign near-infrared light into heat to ablate tumors with specificity. These polymer-coated nanoparticles are 100,000 times smaller than clinical ablation applicators and are the longest circulating nano-antennas created to date as a result of the polymer coating. After intravenous injection, the nanoparticles continuously circulate through the bloodstream eventually targeting the tumor by leaking into pores within the tumor blood vessels. Once specifically trapped in the tumor, the nanoparticles absorb the infrared light that is applied, due to the superior conducting properties of gold, and efficiently heat and destroy the tumor without affecting healthy tissue. This technology has the potential to be inexpensively deployed in a number of medical settings to precisely and non-invasively ”sensitize” tumors with heat to improve the efficacy of traditional cancer therapies, clear margins during surgery and overcome drug resistance.




**New Paradigm of 'Systems Nanotechnology' for Targeted Drug Delivery in Cancer Therapy**

Von Maltzahn aims to improve the intravenous delivery method of therapeutics to tumors with his synthetic replicate of the biological process of blood coagulation in which nanoparticles communicate with each other to improve their ability to find tumors. In one of these systems, benign "scout" particles locate the tumor and once inside send powerful signals to rapidly recruit secondary particles or "assassins" that contain the therapeutics to the tumor site. So far, this method has enabled more than 40-fold increases in tumor drug delivery compared to non-communicating systems. If this highly-defined deployment of cancer therapeutics can be achieved clinically, doctors will be able to significantly increase the dose of chemotherapeutics administered to tumors, increasing overall efficacy and reducing off-target side effects.

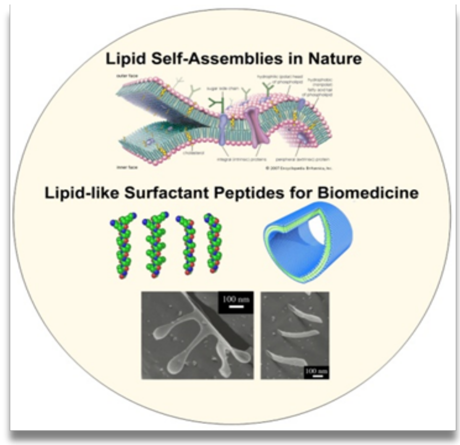
**Artificial Biomarkers for Detecting Hemorrhage in Patients**

Traditional methods of protease detection are either highly invasive, limited to detection of a single enzyme target, or lack the capacity to sample proteases at the site of disease. Von Maltzahn developed a method for tethering short protease substrates to long-circulating, disease-targeted nanoparticles. These nanoparticles accompany the substrates into regions of disease, bringing them into close contact with proteases there, and allowing free peptides to rapidly excrete into the urine due to their small size. There, they can non-invasively detect hemorrhaging or other protease-rich events.

Using the same technology, von Maltzahn developed a way of ”bar-coding” the identity of substrates so that thousands of them can be distinguished in a single sample, enabling very complex protease profiles to be deciphered in a single patient. This method can remotely detect the chorus of proteases activated in hemorrhaging and is showing promise for cancer detection. It additionally has potential applications in Alzheimer's disease, identification of patients going into shock and sensing infections.

**Sensors for Detecting Tumor Protease Hot-Spots in MRI**
Working in a team, Von Maltzahn built and patented a process that allows inactive nanoparticles to improve MRI detection of tumor protease expression. This series of nanoparticle sensors remains dormant in the blood, much like platelets, and becomes activated to rapidly assemble in the presence of tumor proteases. This invention could potentially lead to more effective methods for detecting early metastatic lesions and probing the invasiveness of cancers.

**Self-Assembling Lipid-like Peptides for Biomedicine**
As an undergraduate student, von Maltzahn designed a new family of lipid-like peptides for DNA delivery into cells. In addition to their promise in gene therapy, these peptides have shown use in drug delivery and photoreceptor stabilization for bio-inorganic solar cells.




*Images provided by Geoffrey von Maltzahn*