

## **Pericardial Inotropic Drug Delivery for Acute and Chronic Heart Failure**

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Frustrating challenges confront patients with heart disease and their physicians. 4.8 million Americans suffer from heart failure. While some can lead productive but limited lives with careful medical management, diet and fluid intake, disruptions in these regimens can be devastating.

We propose direct, transient application of stimulants to the outer surface of the heart. Experiments in small rodents and large mammals have produced exciting data. Direct application produces prolonged and stable myocardial effects with reduced peripheral side effects. Two patents have been filed protecting the pericardial application of inotropes and others are in preparation. We envision several applications of this technology. A pericardial inotrope releasing patch to be applied by a cardiothoracic surgeon during open heart procedures is designed to help cardiac surgical patients with heart failure separate from cardiopulmonary bypass and support their hearts in the intensive care unit, shorten their stay in the ICU and decrease nursing care. These applications address several large markets and constitute a diverse product line with a single core technology.

## **Water purification at DEKA Research & Development**

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For the first time, i-Teams is offering a project from a non-academic lab but the project remains at the nascent proof-of-concept stage. The opportunity to understand the market potential and to propose an effective go-to-market strategy for the technology developed in DEKA labs is an exciting one. Ensuring access to clean water is one of the greatest challenges faced by under-developed countries. Existing approaches to water purification require expertise in system design, operation and maintenance. DEKA set out to design a simple system that transforms any source water into safe drinking water. The company is now working to move from concept machines to volume production. <http://www.dekaresearch.com/water.shtml>.

## **Drug-Eluting Contact Lenses**

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Given their ability to greatly increase regimen compliance, drug-eluting contact lenses have been an enduring industry goal. However, no such product currently exists in the market. Our technology was developed by experts in the fields of eye disease and polymer drug delivery from both Harvard Medical School and MIT. The close partnership between Dr. Dan Kohane's laboratory at Children's Hospital Boston, Massachusetts Eye and Ear Infirmary and Dr. Bob Langer's Laboratory has produced a contact lens that has controlled drug release for an extended period of time (months). Moreover, the contact

lenses uses only materials that are already FDA approved for ocular use and can serve as a platform capable of eluting any drug to the eye. The patent-pending technology has been enthusiastically received by the ophthalmology community and has been published by a leading ophthalmic medical journal. MIT and the inventors are interested in commercializing the technology.

### **Large Scale Synthesis of Catalysts for Enantioselective Epoxidation**

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A practical, efficient, and large-scale synthesis of very useful catalyst for enantioselective epoxidation has been developed. These chiral epoxides are useful in fragrances – both for detergents and in the fine perfumes business – as well as agribusiness. Fragrance companies such as Firmenich might be interested in purchasing the ent-Shi catalyst for, ideally, a large-scale manufacturing process. Basically any company that makes and sells chiral epoxides is a potential customer of company or companies end up selling the ent-Shi catalyst.

This invention has been reduced to practice and over 200 grams of the ent-Shi ketone have been prepared in our MIT laboratories. With the manufacturing facilities available at fine chemical companies, this synthesis should be possible on multi-kilogram scale. As shown in the attached Scheme, the synthesis starts with L-ascorbic acid (vitamin C), a very inexpensive material. It is converted to (S)-glyceraldehyde derivative 1 in 3 known steps. Aldehyde 1 is commercially available (e.g., from Aldrich), and thus the synthesis can alternatively begin here. Compared to competing synthetic routes, the subject of this invention (Scheme) has been demonstrated to be very scalable and is several steps shorter than the competing published synthesis.

### **Noninvasive Hydration Monitor**

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Numerous health conditions, including congestive heart failure, kidney disease, and diabetes, either lead to dehydration or are treated with diuretics that cause dehydration. In fact, diuretics are the third most prescribed drugs among patients over 65 years of age (nearly 40 million Americans and growing at 8% per year). In these patients, hydration must be closely monitored to prevent dehydration, which typically causes a decrease in blood pressure and, in extreme cases, can result in kidney failure, shock, coma, and death.

Dehydration is primarily clinically diagnosed using qualitative markers such as vital signs, temperature, and skin elasticity. Less often, invasive methods are used to achieve more accurate measurements. These methods require blood samples and lab tests that are painful, costly, and time consuming. We are currently developing a device that uses advanced engineering techniques to noninvasively extract biomarkers directly correlated to hydration. It painlessly achieves accurate measurements by using 1) a novel sensor design that leverages the unique electrical properties of muscle tissue, 2) hardware capable of quickly extracting large amounts of accurate data from the patient, and 3) algorithms that can robustly compute biomarkers from the data.

## **Cross-culture Cameras**

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The Camera Culture group at the Media Lab conducts multi-disciplinary research in modern optics, sensors, illumination, actuators, probes and software processing. This work ranges from creating novel feature-revealing computational cameras and new lightweight medical imaging mechanisms, to facilitating positive social impact via the next billion personalized cameras. Three projects from the group that are promising for business development are the Bokode, BiDi Screen and Second Skin. The Bokode is a discreet tag that codes information in view angle, such that it can be read by a defocused camera, but appears to be a small inconspicuous dot to the human observer. The BiDi (bidirectional) Screen combines 3D gestural input and a 2D display in a single thin device by exploiting large area sensor arrays and mask-based light-field capture. The Second Skin is a motion tracking system that allows faster and more accurate tracking at an order of magnitude lower cost by replacing the traditional elements of a motion tracking system: passive tags are replaced by tiny photosensors and cameras are replaced by LED arrays.

## **Digital Aperture, Light Field Camera**

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We have developed a technology which allows a standard consumer camera to capture full-resolution 5-dimensional light fields. A light field is a complete physical model of the light emanating from a scene. From this 5D data we can display perspective changes in the natural, intuitive way that our brains would process the same scene. We can also calculate accurate 3-dimensional depth maps, precise enough for use in science and engineering applications. The technology allows a standard camera to shoot 3D movies with the touch of a button. Ours is a convergent technology, allowing a single camera to do everything from light field capture to simple point-and-shoot, all through the elegant, digital manipulation of the aperture.

## **FaceSense – capturing emotions in the face**

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This Media Lab technology provides respectful solutions for the measurement and communication of emotion. One the key technologies, FaceSense, captures emotional valence information ranging from “positive” as in genuine enjoyment smiles, to “negative” as in frowning or wrinkling the nose while people interact with a new product or service, without interrupting or interfering with their experience. FaceSense can also capture other important expressions conveying interest, confusion, and more. FaceSense was originally developed to help people diagnosed with autism spectrum disorders; however, it opens up entire new fields of application, including market research, audience feedback, entertainment, business process, and education. Today, only big organizations can afford to spend

millions, sometimes billions, on testing new products or services before going to market. For smaller companies such tools are far too expensive and time-consuming.

Our vision is to change that by providing FaceSense as an affordable software service that is accessible by all. Because the roots of the technology grew out of helping the disabled, Affectiva is committed to supporting a line of products for such needs. We join a number of successful businesses like *Ben and Jerry's* and *Newman's Own* as a dual bottom-line company that will be both a profitable commercial business and a respected vehicle for promoting social good.

### **Dypol – Proton Exchange Membrane**

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The technology is a novel proton exchange membrane. Early data shows superior performance in direct methanol fuel cells but the membrane could have other applications in additional markets like chlor-alkali, hydrogen sensors, electrolysis, ozone generation, and medical devices (ie. glucose meters/detection). Need to understand market opportunities other than fuel cell as well as solidify a business/commercialization strategy as well as best route to develop the technology (ie. focus on novel material discovery, move forward with current proprietary membrane material,etc.)