Inside R&D Alert (TechVision)

Research and Development Initiatives in Optical Coherence Tomography, High Strength Metals, Zika Virus Testing, Grid Energy Storage Batteries, and Transformers

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Innovations in Optical Coherence Tomography, High Strength Metals, Zika Virus Testing, Grid Energy Storage Batteries, and Transformers
Viewing Cells Under the Skin in 3D

Problem Statements

Scientists have found optical coherence tomography (OCT) to be a promising way to study cells under the skin to improve diagnosis and treatment of disorders such as cancers and blindness.

Their efforts are limited because OCT is not sufficiently sensitive to enable scientists to distinguish individual cells.

Technology Profile

Who: Stanford University scientists have developed a novel technique to view cells and molecules under the skin in three dimensions.

What: The team’s technique combines OCT with gold nanorods and observed the light scattered by the nanorods implanted in a living mouse. Computer algorithms converted these light signals into three-dimensional, high resolution images.

What are nanorods?

These are a morphology of objects on the nanoscale, ranging from 1 to 100 nanometers, that are made from metals or semiconductor materials.

Innovation Attributes

Can detect macular degeneration, a leading cause of blindness, earlier than other methods

Physicians can track how tumors move to other parts of the body

Can uncover more information on how the blood and lymph vessels function

Future Work

The next step for the team is demonstrating that the nanorods are able to bind to specific cells such as skin cancer to learn how such diseases progress in the patient on the molecular level.

$Funding

The research was funded by the US Air Force, the National Institutes of Health Directors Office, the National Science Foundation, and others.

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Amorphous alloys or metallic glasses are high strength materials that hold potential in valuable aerospace, automotive, and electronic applications.

Two drawbacks are that metallic glasses are quite brittle and their manufacture in large volumes is limited.

**What are amorphous alloys?**

Unlike metals whose well ordered atoms impart a crystalline structure, amorphous alloys possess an disordered atomic arrangement that makes them non-crystalline and glassy.

**Problem Statements**

Amorphous alloys or metallic glasses are high strength materials that hold potential in valuable aerospace, automotive, and electronic applications.

Two drawbacks are that metallic glasses are quite brittle and their manufacture in large volumes is limited.

**Technology Profile**

**Who:** A scientist at the Stony Brook University is researching ways to engineer interfaces into metallic glasses in order to improve their durability, formability, and strength.

**What:** The scientist will use atomistic simulations to design amorphous alloys with novel interfaced at the atomic level. Then, he will make and characterize the alloys to gain greater knowledge of deformation mechanisms at the nanoscale.

**Future Work**

The academic scientist will continue his research at Stony Brook on transforming applications for high strength metals.

**$Funding**

The scientist has received a National Science Foundation CAREER funding of $500,000 over the next five years to support his research on metallic glasses.

**Innovation Attributes**

Provide next generation of materials for value added electronics, automotive and aerospace applications

Research promises large-scale production of more durable amorphous alloys

Amorphous alloys provide more electrical resistivity, higher physical and tensile strength than steels

Metallic glasses are more resistant to plastic deformation

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Investigational Kit for Zika Virus Testing in Donated Blood

Problem Statement

Zika fever or Zika virus disease is a viral infection that is spread by the Aedes mosquito. Originally endemic to the equatorial belt, it has spread to South America, Mexico, and Asia. In 2015, it was declared a pandemic, with over 300 cases reported in the United States, all among people who travelled.

The fear of the virus spreading through blood donations has led countries such as Puerto Rice and Brazil to import several thousand units of blood. Currently there are no known treatment or vaccinations available. Hence, it is important that donated blood is tested for virus before being administered to patients.

Innovation Attributes

The cobas® platform is an automated, high-throughput nucleic acid test system. It is capable of performing nucleic acid extraction, purification, amplification using polymerase chain reaction (PCR) and detection. The system enables fast, high volume and quantitative testing.

The IND status does not imply clearance for clinical or commercial use. Rather, it is a clearance tool for specific test laboratories to use the cobas kit and test systems under specific protocols. Further, these labs must enroll in an ongoing clinical research study.

Innovation Spotlight

- Roche Diagnostics, the diagnostics arm of Switzerland-based Roche Holdings AG, has developed a nucleic acid screening test that will detect the presence of Zika virus’ RNA in the blood plasma.
- With this new kit, it would be possible to test donated blood specimens for Zika virus infection before clinical use.
- On March 31, 2016, Roche’s cobas® Zika assay was authorized by the US Food and Drug Administration (FDA) to be used as a screening tool by testing laboratories under an Investigational New Drug (IND) protocol.

Future Directions

- With the incidence of Zika virus growing in South America and continental USA, the US FDA has declared that areas that have a virus circulation should only collect blood from areas that are safe from the virus.
- In order to ease the burden on blood importing into South and Central America, the IND status of the cobas kit will enable it to be used as a screening tool for blood. In other words, the test will be a necessary tool in order to source blood from virus infected areas.
- At the next stage of expansion, Roche will seek to extend the jurisdiction to southern US states. Finally, Roche will work with regulatory agencies around the world to have similar arrangements.

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Batteries enable smooth utility operations and power them. The problem with solid batteries is that they exhibit deterioration properties such as cracking of electrode particle. They also exhibit a reduction in storage capacity with every charge.

**Technology Profile**

Researchers from the Massachusetts Institute of Technology have come up with liquid electrolyte batteries that provide solutions to all the problems associated with solid electrodes used in conventional batteries.

**Liquid Electrodes for Batteries**

The liquid battery has three layers of different liquids that act as electrodes and a separation layer in the middle. The molten salt layer prevents the mixing of the other electrode layers on either side of it. This layer also acts as the electrolyte that enables passage of ions between the electrodes. These liquid batteries can store large amounts of energy effectively at lower costs and have longer life spans.

As liquid electrodes are used in these batteries they do not face problems related to solid electrodes. The electrode particles are also reconstituted easily during every charge cycle, which is more difficult in a solid electrode battery.

**Working and Performance**

Researchers have tried to make the liquid electrolyte batteries more affordable for common applications such as day to day usage by using commonly available metals and elements. They have used calcium in the electrodes and also in the electrolyte. Since calcium is highly cost-effective, it can successfully reduce the cost of the battery. Calcium’s high melting point for usage in electrolyte was solved by alloying it with magnesium, which is abundantly available. The salts used in electrodes included lithium chloride and calcium chloride in which the electrolyte alloy will not dissolve.

**Funding**

The research was supported financially by the US Department of Energy (DOE)'s Advanced Research Projects Agency-Energy.

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Iron Nitride Transformers

**Problem Statements**

Size constraints in transformers have always hindered development of high performing energy storage systems.

Due to inefficient transformers, there has been constraints in adopting renewable energy on a larger scale.

**Technology Profile**

Who: Researchers from Sandia National Laboratories along with researchers from Stan Atcity of Energy Technologies and System Solutions.

What: Developed a new magnetic material using FAST (field-assisted sintering technique), which enables manufacturing of lighter, inexpensive, and high performing transformers.

**Innovation Attributes**

- Physical characteristics of the material enhances power handling capacity and efficiency.
- Capable of multiple deployment with minimized assembly and validation time.
- Transformers could be made 10 times smaller than the current ones by this method of manufacture.
- Iron nitride transformers require only air cooling.

**What is FAST manufacturing**

Powders of iron nitride obtained by ball-milling iron powders in liquid nitrogen and ammonia are solidified through a field-assisted sintering technique (FAST) at low temperature and pressure.

**Future Work**

Focused on refining the manufacturing process for meeting better power-conversion demands.

**Funding**

This research is part of an integrated project, titled Energy Storage Program, which is funded by the US DOE.

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