Femtoampere Signal Measurement

Revolutionizing Precision: Explore the Future with Chip-Integrated Femtoampere Measurements

Positive Impact

Lowering the signal detection limit to increase detectivity of medical, environmental, safety, and industrial events.

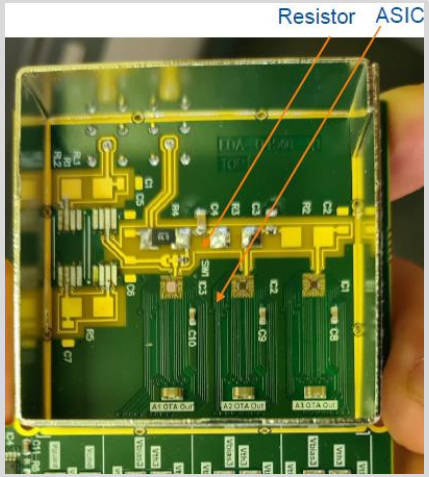
Initial Validation

CERN has developed and built multiple of these sensors to be used for their particle research. Showing improved performance compared to the state of the art.

Problem

A femto-ampere meter, typically abbreviated as "fA meter," is a highly sensitive instrument used to measure extremely low currents on the order of femto-amperes (10^-15 amperes). These minute currents are often encountered in specialized scientific research, particularly in fields like nanotechnology, semiconductor physics, bioelectronics, and molecular electronics.

However, the current femto-ampere meters are **expensive and cumbersome.**



Call to Action !!!

We are looking for business developers, electrical engineers, nanotechnology and material scientists, physicists, optical engineers to develop this technology into a market ready product.

If you are interested, please reach out to entrepreneur@hightechxl.com

Solution

The femto-ampere meter designed at CERN, the European Organization for Nuclear Research, is unique due to its capabilities tailored specifically for the high-energy physics experiments conducted at the facility. It provides **high accuracy** and **sensitivity** coupled with **high robustness** and reliability. Moreover, such a device will **cost ~80% less** than the current state of the art.

Technology

→ A novel Application Specific Integrated Circuit (ASIC) have been designed, build and thoroughly verified.

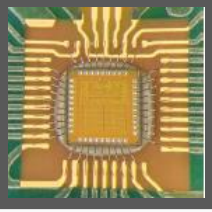
→ TSMC 130 nm

→ 1 fA to 1 uA

→ -7 fA leakage

→ Resolution : 1 fA

→ Technology and Architecture evaluation



Potential Markets

This low cost, high accuracy and sensitivity sensing of signals can be applied in a wide variety of applications. For example:

→ Biomedical Research

→ Environmental Monitoring

→ Surface Science and Nanotechnology

→ Critical infrastructure monitoring

→ Semiconductor Device Characterization

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Fiber Optic Sensing

Unlocking Pressure and Temperature Insights with Integrated Photonic Chips

Positive Impact

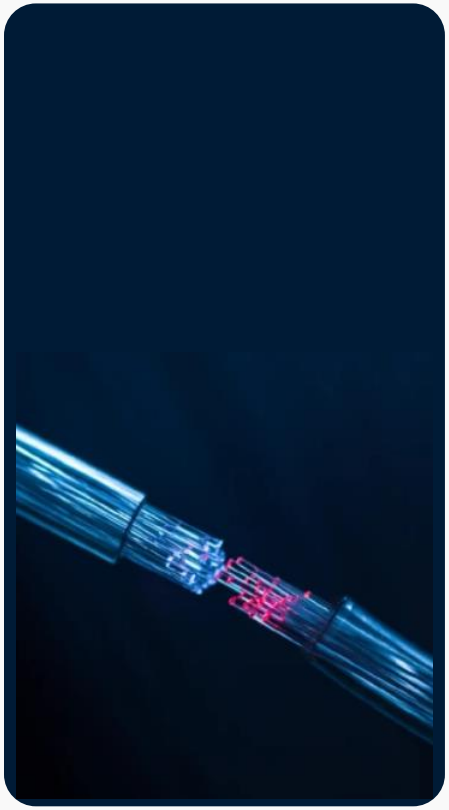
Effective, Efficient, Accurate and Smart sensing, creating monitoring and assessment capabilities that were not viable before.

Initial Validation

PhotonFirst has been developing photonic chips for sensing for over a decade. In their continuous development, the interrogator system is actively in use in different markets with remarkable results. Based on these interactions, the interrogator is constantly improving.

Problem

Sensors have an enormous presence in all sectors. While new technologies are being developed, new sensing capabilities allow companies to produce, monitor, maintain, secure, and provide care more effective and efficient. Photonic sensing is becoming more and more available and new applications and markets are discovered that can benefit from the highly accurate sensing capabilities.



Solution

Optical fiber systems can measure strain and temperature and derivations from these measurands, such as vibration, shape, acceleration and pressure. The interrogator, that connects and measures the sensors, enables the use of one single fiber carrying hundreds of sensors. This single fiber can then be deployed more efficiently than traditional multi cable sensors. In addition, the advantage of using integrated photonics is that multiple electronic components normally required to build an interrogator can be combined on a photonic chip.

Technology

- → Very accurate measurements
- → Large number of sensors, thousands of
- → sensors per interrogator
- → These sensors can be applied to various
- → measurands, e.g., temperature and strain.
- → Sensors can be read over long distances,
- → e.g., 5 or 10 km.
- → The sensors are chemically inert and nonconductive immune to EMI
- → The interrogator can be developed to be
- → very small and low power

Call to Action !!!

We are looking for enthusiastic co-founders to pick up the opportunity and start their entrepreneurial journey with this technology. Specifically, mechatronics, optics, and application engineers and business developers.

If you are interested, please reach out to entrepreneur@hightechxl.com

Potential Markets

This technology has virtually endless sensing opportunities, we need you to develop the latest applications. Think for example of:

- → Battery monitoring
- → Structural health monitoring of critical
- → Interferometric encoding
- → Shape sensing
- → Harsh environment sensing
- → Steel cabling strength monitoring
- → And many more!

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REVERSIBLE POLYMER-SAND COMPOSITES

Shaping the world with affordable and environmentally friendly composites

Positive Impact

Utilizing polymers and sand to create reversible composites that enable industries to shape circular projects

Initial Validation

Several lab tests have been performed to assess some key aspects of this technology. The compressive strength has been tested and is on par with M40 grade concrete. Moreover, tests found that when the material absorbs water, it becomes workable or formable. After curing, the workable material becomes solid again with no compressive strength comprises.

Problem

Producing and transporting concrete is coupled with a large environmental footprint. One of the required materials for the fabrication of concrete is cement which is considered one of the most polluting materials to produce. Moving to Earth based materials would significantly reduce the environmental impact as well as the production costs. Furthermore, the reversibility of the proposed solution enables reusability of the base material. More application specific problems are to be identified and ultimately tackled with the polymer-sand composite.

Solution

A reversible material has been developed that mixes polymers with sand to create a composite with similar mechanical properties as concrete but with a much lower carbon footprint. In addition, the solution uses sand which makes this type of building material literally "dirt cheap". The composite has the capability to becomes workable/formable when it absorbs water opening a plethora of use cases. On the other hand, the reversibility can also be (temporarily) avoided by applying a water repellant coating.

Technology

The basic concept revolves around functionalizing polymers and mixing this with sand. If this substance is subsequently cured, this will create a composite material with compressive strength values that are on par with concrete. When this composite absorbs water (the solvent), it returns to a workable/formable substance. After curing again, the composite solidifies and contains the same mechanical properties as before.

Call to Action !!!

We are looking for co-founders to bring this technology to the market. We are looking for both technical- and business-people with experience in producing and commercializing innovative composites. Furthermore, we are looking **for chemical scientists, material experts and business developers.**

If you are interested, please reach out to entrepreneur@hightechxl.com

Potential Markets

There are several potential markets where this problem is an issue.

Beachhead market

→ Single-use applications such as molding

→ Landscaping & construction solutions

Growth market

→Healthcare applications

→(Elektronic) packaging materials, 3D concrete printing applications

→Other applications such as clay-like toys, educative matierial, art, landscaping walls, sculptures etc.

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Anti-Fouling by UVC Light

Based on integrated photonics

Positive Impact

Maintain operating performance by eliminating harmful biofouling while sustaining marine life.

Initial Validation

The UVC anti-fouling technology has been validated in real-world cases. Tests with different conditions at varying locations have been successfully conducted over an extended period.
Leading global innovator Philips is offering access to this technology through its licensing programs and is in constant pursuit to optimize the current system by increasing the tests in size and duration and by developing next generations to further improve the usability and durability.

Problem

Biofouling is the formation of micro-organisms, plants and other marine life on a surface in contact with water. Biofouling drastically impacts structures' performance and can lead to high maintenance costs.

Today's paint-based solutions, such as copper or other hazardous chemicals, harm marine life and are under pressure from governmental regulations. The performance significantly degrades over time.

Companies that work in, around or with water need to find solutions to reduce fouling without harming nature.

Call to Action !!!

We're looking for co-founders to bring this technology to the market. We are looking for technical and businesspeople with experience in UVC technology, including chemical scientists, marine life experts, bioengineers and business developers.

If you are interested, please reach out to entrepreneur@hightechxl.com

Solution

One of the proven solutions is to completely cover a structure with a light-emitting layer. UVC light is emitted outwards, which in turn completely prevents fouling from adhering to the parent structure.
For this solution, Philips developed an innovative UVC emitting coating. The ultra-low level of UVC light eliminates any biofouling that comes in contact with the surface, preventing its progressive growth while the structure's surrounding structure is not impacted.

Technology

Philips has developed a coating that emits just enough light to eliminate biofouling while withstanding harsh environments such as sea water for many years. This innovative solution allows the UVC transparent layer to be used without a harmful level of UVC light penetrating the water. This results in perfectly clean surfaces that do not require maintenance over the lifetime of the structure.

Potential Markets

There are several potential markets where this problem is an issue.

Beachhead market

→ Fish farming systems

→ Structures in seawater (pipe systems, buoys)

→ Engine Inlets

Growth market

→ Energy systems at sea (windmills, tide/wave-generators)

→ Water management plants Industrial/power plant cooling towers

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A novel process for producing high performing non-oxide ceramics

Opening a new world for materials with unique combination of both ceramic and metallic properties

Positive Impact

Using the patented molten salt process, commercial production of new type of materials with unique properties is possible at relevant scales

Initial Validation

The Molten Salt process has been used to produce a broad variety of so-called MAX phases (non-oxide ceramics) and other high-performance materials, such as titanium alloys for bioimplants and aircraft engineering. The experimentation is currently done at scales of 100s gram of ceramics produced per batch.

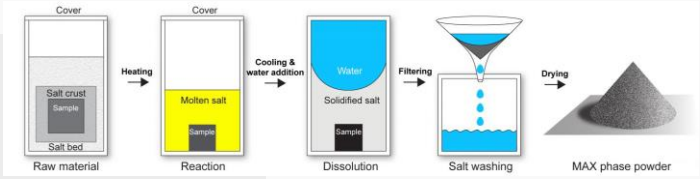
Solution

This problem can be solved using a molten salt process to produce MAX phase powders, since the purity is high and large batches can be produced. This process is simple, cheap, and environmentally-friendly, so it will be attractive to industry.

MAX phases unite the positive properties of both ceramics and metals. They are heat resistant and lightweight like ceramics, yet less brittle, and can be plastically deformed like metals. Furthermore, they are the material basis of MXenes, a largely unexplored class of compounds that are similar to the "miracle material" graphene and have extraordinary electronic properties.

Problem

MAX phases are a new family of non-oxide materials with high potential for high temperature applications due to their unique combination of properties, bridging the gap between ceramics and metals. However, application of MAX phases has been limited due to the difficulties to synthesize large quantities of highly pure powders at reasonable costs. Up to now, synthesis of large batches of MAX phases implies the formation of secondary phases, which have a detrimental effect on the final response of the materials at high temperature. Furthermore, conventional processes to synthesize MAX phases are less attractive for industry due to the high costs associated with the protective atmospheres and milling steps.



Technology

→ A new method now makes it possible to produce this desirable material class on an industrial scale for the first time. The basis of the technology is to use molten salt as a protection method to prevent the starting material from oxidation at a production temperature of more than 1,000 degrees Celsius.

Afterwards, the salt can easily simply be washed off with water.

Call to Action !!!

We are looking for co-founders to bring this technology to the market. We are looking for both technical- and business-people with experience in producing and commercializing ceramic materials. Furthermore, we are looking for chemical scientists, material experts and business developers.

If you are interested, please reach out to entrepreneur@hightechxl.com

Potential Markets

MAX phases have a diverse range of potential applications due to their unique combination of properties. Examples are

- → Coatings and Surface Treatments
- → High-Temperature Structural Materials
- → Electrodes for Energy Storage
- → Thermal Management Solutions
- → Refractory Materials
- → Electronic and Photonic Devices
- → Biomedical Applications
- → Precursor for MXenes

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