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Refractory Plasmonic Sensors for Harsh Environments

Optical sensor system using refractory plasmonic metamaterials/metasurfaces enables remote, real-time monitoring of harsh environmental parameters such as temperature, strain, and corrosion up to 2500 degrees Celsius without the need for expensive cooling systems.

Process control systems, such as those used in industrial and chemical processing and manufacturing, rely on ambient conditions sensors to provide real time measurement of various physical parameters such as temperature, pressure, surface chemistry, elastic strain, or other mechanical load. These sensors are often deployed in high temperature, chemically aggressive, or mechanically harsh environments, which causes the failure of the electronic devices required for said measurements. Temperatures exceeding a few hundred degrees Celsius may lead to electronic component failure and require the use of a complex cooling system, adding to the complexity and cost of the system.

Researchers at Purdue University have developed an optical sensor system that can withstand temperatures up to 2500 degrees Celsius in chemically aggressive and harsh environments that impose stress, strain, and vibrations. The system uses refractory plasmonic metamaterials/metasurfaces deposited onto the surface of the harsh-environment device to monitor variations in the parameters being measured. This optical sensor system enables remote sensing, which allows for the location of detection sensors and ancillary electronics outside of the harsh environment. This technology provides real time information on harsh environmental parameters such as temperature, strain, corrosion, creep, or fatigue.

Advantages:

-Withstand temperatures up to 2500 degrees Celsius

-Withstand chemically aggressive and harsh environments that impose stress, strain, and vibrations

Technology ID

2017-KILD-67841

Category

Aerospace & National Security/Thermal Management & Combustion Optimization
Robotics & Automation/Perception & Sensing
Materials Science & Nanotechnology/Nanomaterials & Nanostructures

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-Allows for remote sensing

-Allows mapping of measured parameters on a surface

-Provides real time information on harsh environmental parameters

-Does not require expensive cooling systems

Potential Applications:

-Process control systems

-Aircraft and vehicle engines

-Power plants

-Refineries

-Drilling rigs

TRL: 3

Intellectual Property:

Provisional-Patent, 2017-05-12, United States | Utility Patent, 2018-05-14, United States | DIV-Gov. Funding, 2020-03-31, United States

Keywords: Optical sensor system, refractory plasmonic metamaterials, harsh environment sensing, high temperature sensors, remote sensing technology, process control sensors, strain and vibration monitoring, corrosion and creep detection, industrial sensing, high temperature electronics alternative