Analytical Instrumentation, Methods & Materials

Embedded Photonic Sensors for Sensing Workpiece Properties

View U.S. Patent No. 7,840,101 in PDF format.

WARF: P09303US02

Inventors: Xiaochun Li, Chee Wei Wong, Xugang Zhang

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing robust photonic sensors for industrial manufacturing processes.

Overview

Placing sensors that can monitor properties such as temperature and strain directly into a manufacturing environment can allow effective monitoring and control of manufacturing processes. By continuously monitoring critical conditions, problems can be detected and solved during the processing cycle, resulting in improved product quality and productivity. Unfortunately, current sensing technologies are susceptible to electromagnetic interference that can impair monitoring and lead to damaged sensors. Large sensor arrays may require cumbersome and expensive wire assemblies that are also susceptible to harsh heat and electromagnetic conditions. A need exists for sensor devices using alternative modes of data transmission that are less impaired by hostile manufacturing environments, which may include high temperatures, corrosive agents and/or electromagnetic interference.

The Invention

UW–Madison researchers have developed a system and method for sensing properties of a workpiece that are less susceptible to harsh operating conditions. The photonic device of the system may be embedded in a metal layer of the workpiece, allowing the system to be incorporated into a mechanical device without interfering with normal operation of the piece.

The complete system includes an optical input, a photonic device, an optical detector and a digital processing device. The photonic device is coupled to the workpiece and to the output of the optical input, and generates an output signal in response to the optical signal. The intensity and/or wavelength of the output signal depend on the thermal and/or mechanical characteristics of the workpiece. The optical detector receives the output signal and generates a corresponding electronic signal. The digital processing device is coupled to the optical detector and determines the thermal and/or mechanical characteristics of the workpiece.

The system may act as a complete feedback loop that allows parameters of the process to be modified in response to the thermomechanical characteristics of the system. By implementing integrated microphotonic devices, the system allows for sensing and monitoring of thermomechanical variables even in conditions of strong electromagnetic or thermal interference.

Applications

- Thermomechanical phenomena monitoring in manufacturing processes
- Structural integrity monitoring
- Sensing in hostile environments requiring metallic components

Key Benefits

- Allows sensing in hostile conditions such as high stress, temperature or electromagnetic environments

- Enables integration into mechanical structures without interference with normal operation

Additional Information

Related Technologies

- For more information about embedding sensors into metal substrates, see WARF reference number P05140US.

Publications

- Zhang X., Jiang H. and Li X. 2008. Design, Fabrication, and Characterization of Metal Embedded Microphotonic Sensors. J. Manuf. Sci. Eng. 130, 031104.
- Zhang X. and Li X. 2008. Design, Fabrication and Characterization of Optical Microring Sensors on Metal Substrates. J. Micromech. Miecroeng. 18, 015025.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Sensors

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867