



Industrial Consultancy & Sponsored Research (IC&SR)

Integrated Thermocouple Waveguide Sensor System and Method to Measure Physical Properties of Waveguide Material and Surroundings IITM Technology Available for Licensing

Problem Statement

- The problem statement discussed in the present invention is **how to provide a simplified waveguide based integrated sensor system** that measures **both temperature & physical properties** of waveguide and surrounding materials by coupling both ultrasonic effect and thermo-electric effect **without providing separate material and design for creating sensor element at the hot junction.**
- Hence, there is a need to address the issue & said invention provides the solution efficiently.

Technology Category/ Market

- Technology:** Integrated Thermocouple Waveguide Sensor ;
- Industry & Application:** NDT, Level & measurement, Automotive, robotics & etc.
- Market:** The global **Industrial Ultrasonic Transducer** market is projected to grow at a **CAGR of 11%** during the forecast period (2024-31).

Technology

- Present patent describes an **integrated sensor system** for simultaneously measuring the **wave propagation medium** for its **physical properties, rheology measurement & condition monitoring** of surrounding media.
- System comprises a

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•one or more of **compatible wave propagation mediums** linked to an ultrasonic energy transducer at one end as **cold junction**

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•the other ends of the wave propagation mediums are joined together to form a closed end, i.e. a **hot junction** made by one or more of **twisting, bending, bonding, extended welding, spot welding** to provide ultrasonic damped junctions, electrical potential and mechanical strength;

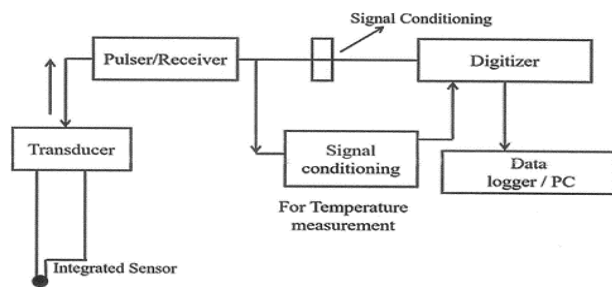


Fig.1 depicts a schematic diagram of the integrated sensor waveguide system

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•**wave propagation mediums** between the **open end & closed end** is characterized with one or more of reflectors such as bends, notches, coatings, the hot junction and gratings, **along the length** to obtain **ultrasonic reflections**;and

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•the **ultrasonic-thermoelectric hot junction/ultrasonic sensor's gage length** measures the **physical properties** of the wave propagation medium and its surrounding medium properties including **rheology and strain parameters** using **ultrasonic waves propagating in the waveguide(s)** in addition to **temperature**

Intellectual Property

IITM IDF Ref. 1803;
IN Patent No. 394597 (Granted)
PCT Application No. PCT/IN2020/050592
US Publication No. US 2022-0291171 A1

TRL (Technology Readiness Level)

TRL-4, Proof of Concept ready, tested and validated in Laboratory

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Images

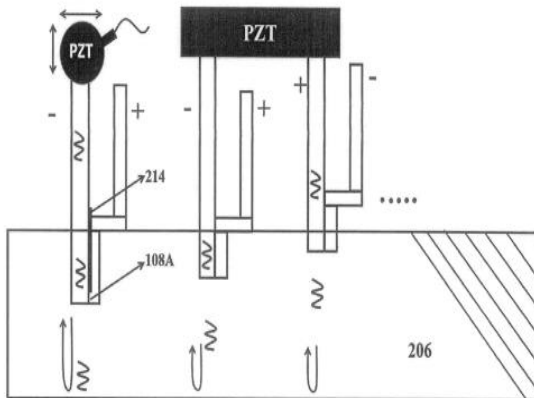


Fig.2 depicts Integrated thermocouple waveguide sensors are inserted inside the rectangular bar (206) at different offset positions for measuring the strains, while heating the sample.

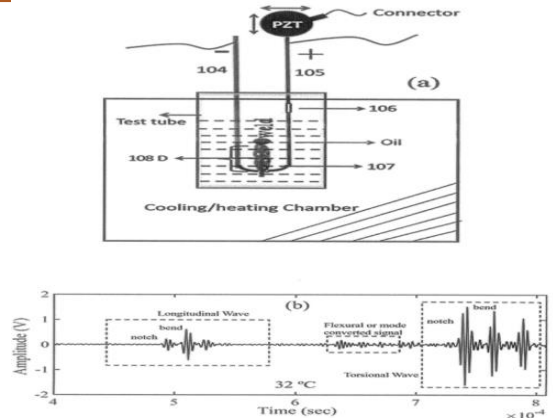


Fig.3 depicts Integrated thermocouple waveguide sensors are inserted inside the rectangular bar (206) at different offset positions for measuring the strains, while heating the sample.

Key Features / Value Proposition

❖ Technical Perspective:

❖ Specimen Testing Process:

- ❑ The **integrated sensor** is **pasted** (using spot welds or high temp glues) to the **specimen for measuring the longitudinal strain, lateral strain, resultant strains and thermal expansion**, while heating the sample.

❖ Transducer:

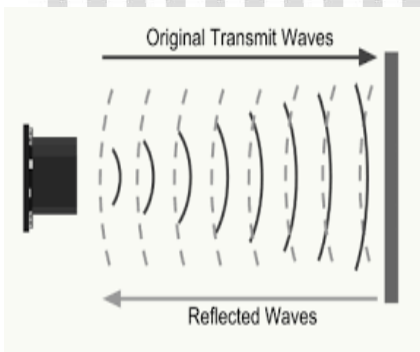
- ❑ Transducer is selected from **PZT, electro-magnetic, thermal means**, or combination thereof.

❖ Active Ultrasonic Sensors:

- ❑ A few **temperature sensor** will function simultaneously and are characterized to **self-calibrate** with respect to each other, upon **failure of hot junction**, either one of the **leads** or both leads will become active ultrasonic sensors.

❑ Other Features:

- ❑ Said surrounding media properties are viscosity, density, temperature, humidity, ice formation, flow, level, etc.
- ❑ Said **wave propagation medium properties** are elastic moduli, longitudinal, lateral, radial strains, diagonal strains, etc., wherein said wave propagation mediums are selected from two dissimilar metals **Chromel & Alumal**.
- ❑ The **means** of ultrasonic energy transduction method is selected from **piezo-electric, electromagnetic, magnetostrictive, thermo-elastic, opto-mechanical, electro-mechanical**.
- ❑ The temperature tolerance for sensing ranges from **-100°C to 2000°C**.



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