III-Nitride based ultrasensitive harsh environment pressure sensor (2023-008)

III-Nitride semiconductor-based pressure sensors capable of operating at high temperatures with much higher sensitivity and lower operating power.

Market Overview

There is a critical need in industry for advanced pressure sensors. Current Si based pressure sensors suffer from lower sensitivity and cannot operate at high temperatures. This novel III-Nitride semiconductor-based pressure sensor can operate at high temperature with a significantly greater sensitivity and lower operating power compared to existing Si piezoresistive sensors. With a total addressable market of $500 million, there are a wide range of potential market applications for this technology, including automotive, avionics, industrial and various consumer applications, where Si based sensors do not meet the requirements for high temperature, high sensitivity operation.

Technical Summary

The invention incorporates several innovative aspects in the device design aimed at addressing the current limitations of Si based pressure sensors. These innovations include: (i) the usage of wide bandgap and inert III-Nitride semiconductors that are capable of operating at high temperature and harsh environment, (ii) ultrahigh sensitivity and low operating power arising from deflection transduction of pressure membrane using gate tunable piezoresistive AlGaN/GaN HFET, (iii) operation in enhancement mode to ensure compatibility with existing sensors using only positive supply voltage, (iv) usage of low defect density III-Nitride layers grown on HVPE GaN template for high device reliability. The use novel GaN MEMS sensors allows up to 100 times higher deflection sensitivity than Si based sensors, due to the unique piezoelectric properties.

Application

Automotive, avionics, industrials, consumer products

Development Stage

Available for licensing

Advantages

- Operates at high temperatures with much higher sensitivity and lower operating power.
- Novel GaN MEMS sensors allow up to 100 times higher deflection sensitivity.
- Ensures compatibility with existing sensors by only using positive supply voltage.
- High device reliability.
- Wide range of market applications.

About the Inventor

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Dr. Koley joined Clemson University in 2014 as a Professor in the Department of Electrical and Computer Engineering. He has authored or co-authored more than 50 refereed journal articles, 2 book chapters, and more than 110 conference proceedings and presentations. Dr. Koley's research has also resulted in 3 issued patents and 4 invention disclosures. He is a co-founder of 3 start-up companies, a senior member of the IEEE, and a member of the APS. Dr. Koley's current research efforts focus on the investigation of micro and nanoscale materials for electronic, optical, and sensing applications.

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