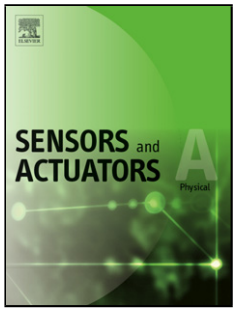

Title: LANGASITE CRYSTAL BASED PRESSURE SENSOR WITH TEMPERATURE COMPENSATION

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LANGASITE CRYSTAL BASED PRESSURE SENSOR WITH TEMPERATURE COMPENSATION

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Highlights

- Design and fabrication of a langasite pressure sensor with self-temperature compensation for harsh environment applications
- Good match between theoretical modelling and experiment
- Fabricated sensor prototype for the validation of the theoretical results

ABSTRACT

This paper presents the design and testing of a new pressure sensor utilizing a doubly rotated cut piezoelectric langasite (LGS) crystal resonator with temperature compensation. The sensor can measure temperature and pressure simultaneously by using the dual mode nature of the doubly rotated cut langasite resonator (SBTC). The sensor is designed using CAD software, fabricated and tested experimentally in the laboratory for a pressure range from 0-45 PSI. Before fabrication the sensing principle was verified performing a force frequency analysis on the langasite resonator using a special apparatus. The experimental results on the sensor shows a good linear relationship between applied pressure and C-mode frequency. Temperature compensation is also achieved by utilizing the dual mode behavior of the LGS crystal resonator. The comparison between our experiment and Peer's theoretical modelling results shows a reasonable consistency. The sensor structure is very compact, robust, low cost and temperature compensation can be achieved at high temperatures particularly in nuclear applications.

Keywords: Langasite, pressure sensor, temperature sensor, dual mode

INTRODUCTION

Pressure is an important physical parameter to be measured in almost all fields of engineering and industrial applications. Pressure measurements are not only important for monitoring and control, but also for measuring other parameters like flow and level through differential pressure arrangement. During the last two decades, different types of pressure sensors were proposed and can be distinguished by their actuation and readout principles [1-4]. Pressures sensors based on crystal resonators are very well established and widely used in exploration and development of oil and gas reservoirs. The advantage of these QCR based sensors is that they operate at very high frequencies in the range of MHz with high accuracy, Q factor and resolution, which is usually a limit for other conventional pressure sensors.

Langasite crystal resonator sensors operating in thickness shear mode has emerged as one of the most popular sensing systems because of its high sensitivity, high accuracy, high temperature stability, portability, reliability in measuring various physical, chemical and biological quantitates. In thickness shear mode (TSM), the resonator undergoes shear displacement upon excitation and