Contribution ID: **466** Type: **Poster Presentation (120m)**

Design, Fabrication, and Characterization of an Interdigitated Micro-Capacitive Level Sensor Coupled with Signal Conditioning Circuit

Wednesday 24 July 2024 14:00 (2 hours)

Cryogenic liquid level sensors play a vital role in industries handling ultra-low temperature cryogens, including medical, aerospace, and energy sectors. Monitoring levels within cryogenic storage tanks is critical to prevent issues such as pressure buildup from overfilling, insufficient supply from underfilling, and temperature fluctuations. Depending on the precision required, level measurement in cryogenic storage tanks can be either continuous or discrete, tailored to the specific demands of the application. In the case of large cryogenic storage tanks, discrete-level measurement methods such as optical fiber point-level sensors, optical frequency-based point-level sensors, and hydrogen depletion-type capacitive sensors are commonly utilized due to their practicality. For specific applications such as level monitoring of liquid propellants(LH2) in launch vehicle storage tanks, hydrogen depletion capacitive-type level sensors are often preferred. These sensors operate on the principle that the capacitance between two plates changes with the variation in its permittivity as the level of hydrogen increases or decreases. However, these sensors tend to be quite heavy, constituting a significant portion of the overall weight of the sensor module.
In this paper, we report the design, development, and characterization of an Interdigitated micro-capacitive (IDC) level detection sensor coupled with its signal conditioning unit, which can be the best alternative for the above application. The developed sensor is very compact, and lightweight (128 mg), has low power consumption, and high sensitivity. They were also compatible with cryogenic settings, where precise and reliable sensing is essential. Functioning on the principle of capacitance modulation caused by alterations in the dielectric medium, IDC sensors are capable of exhibiting capacitance variations typically ranging from 20 to 100 femtofarads, enabling the detection of even subtle dielectric changes. The sensor has an overall size of 7mm diameter, and features six interdigitated fingers per electrode, each having a width and pitch of 250µm. The IDC sensor was designed and modeled using COMSOL Multiphysics FEM software. A customized signal conditioning circuit was also developed to enhance the precision sensing capabilities of the developed IDC sensor. The circuit includes a matched set of monostable multi-vibrators along with a set of digital components that provide the difference in the timing pulses. The generated timing pulse is fed to an averaging circuit to produce voltage corresponding to capacitance variations. The response time of the sensor along with the parameters will be discussed in the paper.

Acknowledgment
The authors gratefully acknowledge Suracsh Filters Pvt Ltd for funding this work.

Submitters Country

India

Author: Mr KRISHNA RAJ, Hrithik

Co-authors: Mr OOMMAN, Anoop (Cochin University of Science and Technology); Mr N, Asil (Cochin University of Science and Technology); Mr MORRIS, Ashley (Cochin University of Science and Technology); NAZER K H, Abdul (Department of Instrumentation, CUSAT); VENUGOPAL, Namitha (Cochin University of Science and Technology); Ms V K, Chinnu (Cochin University of Science and Technology); Dr SAGAR, Pankaj (Cochin University of Science and Technology)

Presenters: Mr KRISHNA RAJ, Hrithik; Dr SAGAR, Pankaj (Cochin University of Science and Technology)

Session Classification: Wed-Po-2.4

Track Classification: Tracks ICEC 29 Geneva 2024: ICEC 11: Instrumentation and process control