MAR08-2007-020110

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Laser Interferometry for Harsh Environment MEMS Sensors

PATRICIA NIEVA, University of Waterloo

Silicon-based MEMS technology has enabled the fabrication of a broad range of sensor and actuator systems that are having a great impact in areas that benefit from miniaturization and increased functionality. The main advantage of Si-based MEMS technologies is their possibility of integration with microelectronics thus allowing the economical production of smart microsystems. In the automotive industry for example, there is a need for inexpensive smart MEMS sensors for engine control applications. For instance, smart MEMS sensors capable of operating "in cylinder", where temperatures are around 400 $^\circ$C, could continuously monitor the combustion quality of the cylinders of automotive engines thus leading to reduced emissions and improved fuel economy. However, when the environment temperature is too high ($>$180 $^\circ$C), conventional Si-based microelectronics suffer from severe performance degradation, thus making smart Si-based MEMS impractical. Hence, further development, in terms of new MEMS materials and/or new technologies, is needed especially where high temperature capability is crucial to realizing improved electronic control. Remote sensing through optical signal detection has major advantages for safe signal transmission in harsh environments. It is highly resistant to electromagnetic interference (EMI) and radio frequency interference (RFI) and at the same time, it eliminates the necessity of on-board electronics, which has been one of the main obstacles in the development of smart MEMS sensors for high temperature applications. An economical way to deal with higher temperatures and other aggressive environmental conditions is to build MEMS sensors out of robust materials (e.g. Silicon nitride, SiC) and integrate them with optical signal detection techniques to form MOEMS. In this paper, we review recent trends for the use of laser interferometry for MEMS sensors in the context of using them for high temperature applications. Technological challenges faced in the development of these sensors, including sensitivity to measurement errors, packaging and cost reduction are also outlined. Finally, an overview of Fabry-Perot like MEMS sensors for high temperature applications is presented and issues facing their future progress and economical implementation are discussed.