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Compact Optical Sensors for Harsh Environments

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Abstract : Optical miniaturized sensors with remote readout are required devices for the monitoring in harsh electromagnetic environments. As an example, in turbo and hydro generators, excessively high vibrations of the end-windings can lead to dramatic damages, imposing very high, additional service costs. A significant change of the generator temperature can also be an indicator of the system failure. Continuous monitoring of vibrations, temperature, humidity, and gases is therefore mandatory. The high electromagnetic fields in the generators impose the use of non-conductive devices in order to prevent electromagnetic interferences and to electrically isolate the sensing element to the electronic readout. Metal-free sensors are good candidates for such systems since they are immune to very strong electromagnetic fields and given the fact that they are non-conductive. We have realized miniature optical accelerometer and temperature sensors for a remote sensing of the harsh environments using the common, inexpensive silicon Micro Electro-Mechanical System (MEMS) platform. Both devices show highly linear response. The accelerometer has a deviation within 1% from the linear fit when tested in a range 0 – 40 g. The temperature sensor can provide the measurement accuracy better than 1 °C in a range 20 – 150 °C. The design of other type of sensors for the environments with high electromagnetic interferences has also been discussed.

Keywords : optical MEMS, temperature sensor, accelerometer, remote sensing, harsh environment
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