

## **Rubber Based Strain Sensor for Detection of Tyre and Road Conditions**

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Detection and measuring of larger strains as those exist in rubber components has long been a requirement that had met with limited success. Compared to traditional metallic strain gauge, elastomer based strain sensors would be more durable in situations where strains are larger and not uniaxial, as those exist in automotive tyre walls and rubber springs. Detecting road conditions or the health of the tyre using a sensor mounted on the surface of a tyre wall is a possibility that opens up a number of possibilities with regard to vehicle safety.

When a normally electrically non conductive polymer is partially filled with a conductive filler, the electrical conductivity of the polymer increases, proportionate to the filler content. However, when a strain is applied, conductive path will be disturbed due to redistribution of the filler and the electrical properties will be changed. This phenomenon has been used as the sensing mechanism of this sensor. Nitrile rubber has been used as the base material for the sensor while carbon black was used as the active filler. The concentration that initiate continuous electrical conductive path is called the percolation threshold concentration. Sensing part was developed using the threshold concentration as a guideline to maximize the sensitivity to the strain. The sensing part that would be applied in inner surface of vehicle tyre would be stretched when a the tyre flexes due to uneven road surfaces or incorrect inflation. An electronic circuit detects the resistivity variation in sensing part which is representative of the flexing of the tyre according to the shocks on vehicle tyre. The detected signal needs to be decoded to its source.

The experimental results on the performance of the sensor indicated extremely large changes in electrical conductivity of the sensor within a short span of strain which is preceded and succeeded with a region of strain having a moderate sensitivity. One of the observed drawbacks of the sensor was its relatively high recovery time.