講演番号	293

Method of Simultaneous Multi-Point Instantaneous Contact Pressure and Temperature Measurement on Gear Tooth Surfaces Using by Thin-film Sensors.

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KEY WORDS: **Power transmission, Gear/Gear system, Strength,** Contact pressure and temperature, Thin-film sensor (A2)

This paper introduced the characteristics of thin-film sensors, which are primarily capable of measuring dynamic pressure, temperature, and strain during actual operation. Application examples of thin-film sensors on the tooth surfaces of spur gears and helical gears in drive systems were presented. To summarize the content:

The criteria for selecting the sensor's film structure depend on whether the component being measured is conductive or non-conductive. For sliding surfaces, rolling surfaces, and contact surfaces, the film thickness of the thin-film sensor varies significantly depending on whether the opposing object is conductive or non-conductive. In other words, the fundamental design of the sensor structure differs for materials such as engineering plastics. (2)The film structure changes due to shear strain caused by changes in contact configuration, such as increases in load torque or speed. When designing thin-film sensors for specific contact configurations, it is necessary to consider the smooth surface of the sensor after fabrication. (See Figure 1&2) (3)When comparing the maximum values of the Hertzian stress and the measured values against the load torque, the two values tended to converge as the load torque increased. One reason for this is believed to be that the contact state becomes more uniform in the tooth root direction. (See Figure 3) (4) The measured values of gear tooth surfaces obtained via Hertzian contact and thin-film sensors tended to converge as the load torque increased. One contributing factor is believed to be the uniform convergence of the contact conditions along the tooth root direction. (See Figure 3) (5)While the Herz pressure and the measured values from the thin-film sensor yielded different results, the distribution of contact pressure generally converged when using a calculation method that accounts for tooth surface geometry and assembly errors. These considerations are necessary when applying MBD to individual gear units.(See Figure 4)

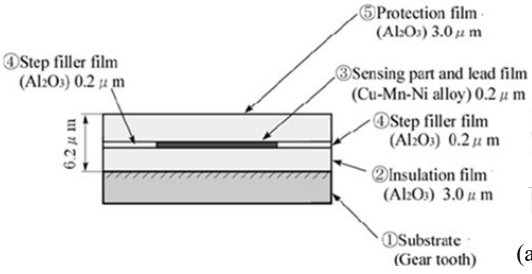
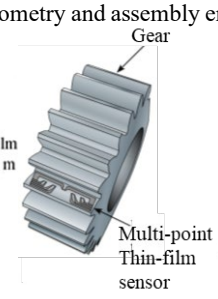
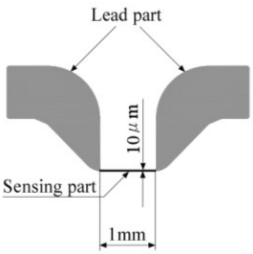


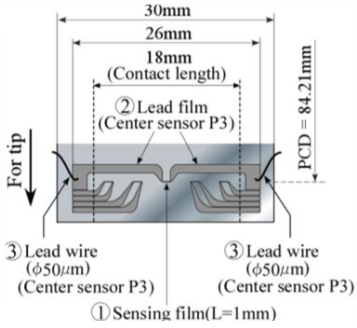
Fig.1 Example of sensor layer structure for gear tooth



(a)Spur gear with thin-film sensors



(b)Sensing part



(c) Example of overall sensor

Fig.2 Thin film sensor shape on driving spur gear tooth

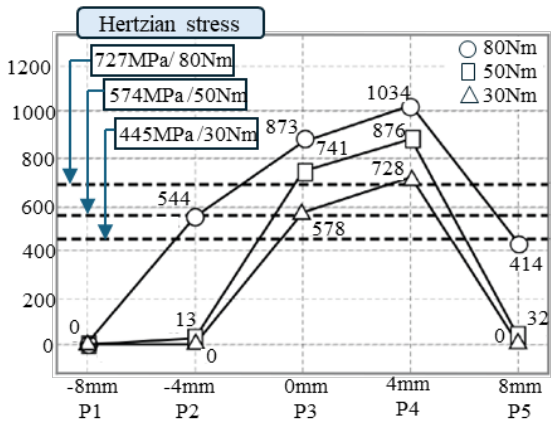


Fig.3 Comparison with contact pressure at each location and Hertzian stress (In case of spur gear)

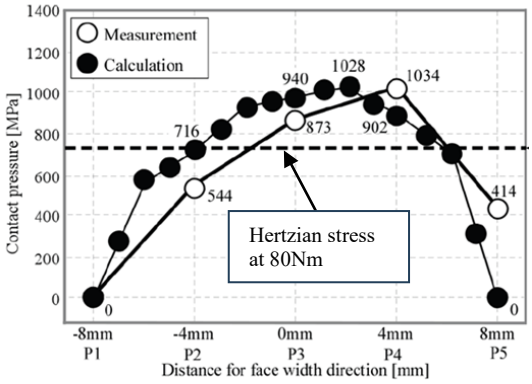


Fig.4 Comparison results of measured and calculation with configuration of teeth trace and misalignment and Hertzian pressure