China applies military hypersonic technology to high-speed trains

Chinese researchers apply hypersonic research results to improve safety for the world's longest, fastest railway network.

According to *SCMP* , a team of scientists involved in the development of hypersonic weapons in China has created a mechanical sensor that could enhance safety on the country's high-speed rail network - the currently the longest and fastest in the world.

The technology relies on small sensors attached to high-speed train wheels to monitor wheel or rail deformation, data that is critical to keeping the system safe and avoiding the risk of derailment. cake.

According to a research team led by expert Feng Xue in the Department of Solid Mechanics at the Academy of Aerospace Engineering of Tsinghua University, the current high-speed rail system can only capture fleeting information. from isolated points.

They proposed using highly sensitive sensor technology, better suited to harsh conditions, to collect complete and continuous data with every rotation of the ship's wheels.

The sensor not only has the ability to collect wheel deformation data (which was previously overlooked), the researchers say, but can also help engineers pinpoint flaws. on rails with unprecedented precision, eliminating risk from the start.

China operates the world's most complex high-speed rail network and has a safety record that surpasses that of commercial aviation, with no passengers killed in high-speed train accidents in the past decade.

China's entire vast railway network is longer than the equator, and next year will welcome a new generation of high-speed trains with a maximum speed increased from 350 km/h to 400 km/h.

"Operating such a vast high-speed rail network, ensuring train safety and cutting maintenance costs are key factors in the rail transport sector," said Feng and colleagues. he said in the report.

"When combined with this new sensor technology, we can continuously monitor in real time the impact force between bullet train wheels and rails. This is a turning point for the next generation of bullet trains of China," the research team added.

In the process of designing large-area sensors suitable for high-speed train wheels, Feng's team also encountered a number of obstacles, especially the need to balance low-cost, mass-production capabilities with outstanding performance.

According to the article, the researchers reused common silicon wafers - the most important part of chip manufacturing - as the basis for sensors. They are covered with a thin layer of gold.

Even though gold is expensive, the team kept the cost at an acceptable level, by using it in very small thicknesses for each wafer - just a fraction of the size of a human hair, etched with sensitive patterns. complex transformation using standard photolithography equipment.

These microscopic structures consist of multiple layers of compounds and metals, capable of changing resistance when subjected to pressure variations. When an electric current passes through these layers, their reaction creates signals that indicate any distortions in the wheel's operation.

'Our vertical load tests show that the sensor not only has strong linearity, but is also extremely stable and has outstanding repeatability under cyclic loading', the researchers said . the researcher wrote.

Feng and his team say that in real-world applications, the sensor could be combined with low-noise wireless telemetry technology to send wheel force signals to a data analysis terminal.

Scientist Feng Xue is also currently leading a project funded by the National Natural Science Foundation of China related to sensors for low-level hypersonic vehicles, which can "tear the sky". at a speed seven times faster than the speed of sound.

Extremely high temperatures and pressures during hypersonic flight can deform vehicles, which Feng's team is focusing on, focusing on the failure mechanisms of solid materials and structures during these specific environments.

The hypersonics team's studies require some rigorous assessments, forcing researchers to build sensors that are flexible, scalable, and operate in the harshest environments.

Although China has invested significantly in the development of hypersonic vehicles, these advanced technologies remain largely limited to military applications.

However, a growing number of scientists and engineers involved in China's hypersonic research believe that these advances will gradually be transferred to civil applications and bring China's manufacturing industry to a new level. a new level.

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