



1 *Photolithographic structuring of the merely 200 nm thin chromium coating on the kingpin for the manufacturing of complexly routed conductive traces.*

DEVELOPMENT OF A SENSORY KINGPIN

With the objective of reducing the energy consumption, as well as CO₂, noise, and brake dust emissions when using vehicle trailers, as part of the ev (electric vehicle) trailer project funded by the BMWi an innovative propulsion and control system has been developed for vehicle trailers. The outstanding feature is the manufacturer-independent autonomous mode of operation of the evTrailer, which functions with any conventional tractor unit. At the Fraunhofer IST, within the project a piezo-resistive thin-film system is used to measure force. This system is directly precipitated onto the complex shape of the mechanical connecting link between tractor unit and trailer, the so-called kingpin (see Figure 2). Interaction of the applied components, specifically force measurement sensors, electric powertrain module, traction battery, and battery management system, is ensured through intelligent control algorithms.

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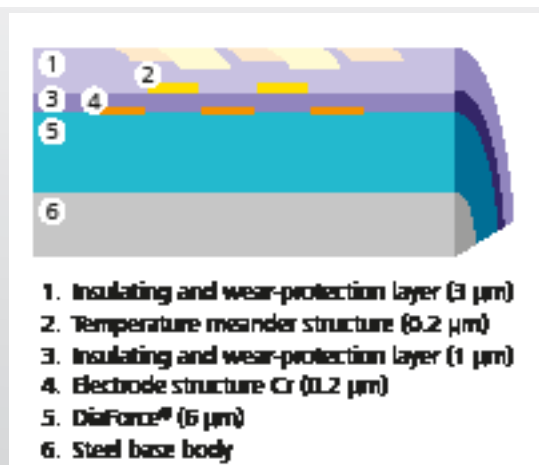
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Task of the sensory kingpin

The sensory thin film system developed at the Fraunhofer IST for local tensile force measurement, is precipitated and structured directly on the three-dimensional surface of a kingpin. With these measurement results an adjustment occurs that should compensate the tensile force or shear force that occurs in the trailer coupling. This means that the energy generated by the braking power, which is recovered via the electric motors at downhill travel, and

which is stored in batteries will, if needed e.g. for uphill travel or for acceleration processes, again be available to the vehicle as drive power. Depending on the load status and the control strategy the tractor “feels” neither the pull, nor the push of the attached evTrailer. Thus, the tractive unit is offloaded, which means that less energy is consumed and CO₂ emissions are minimized.



Development of the sensory kingpin

Within the project the task of the Fraunhofer IST is integration of the thin-film sensors for measuring the load and temperature distribution in the main load zone of the kingpin, which weighs 6 kg. For this the thin film system presented in the figure 3 is precipitated and structured on the manually polished surface of the kingpin in such a manner that the measurement areas are in the upper part. The conductive traces to the contact area must be routed over several edges, so that they can be arranged in the lower screw connection area. Figure 1 shows the complexity of the structuring, in which the photolithography and the wet-chemical etching are combined. The structures running horizontally will later be in direct contact with the locking hook of the fifth-wheel coupling and they will measure the forces occurring under strong frictional load. The meander-shaped structures measure temperature.

Outlook

After the successful manufacturing of the multi-sensor thin-film system on the kingpin surface, the characteristic curves of the piezo-resistive and thermo-resistive sensor structures will be recorded and combined with the measurement technology of the project partner CuroCon GmbH. Then the functionality of the thin-film system will be verified in test runs with a semitrailer from the company Wilhelm Schwarzmüller GmbH.

The project

The described results were achieved within the "evTrailer" project, in which the Fraunhofer IST, together with the Fraunhofer Institute for Structural Durability and System Reliability (Fraunhofer-Institut für Betriebsfestigkeit und Systemzuverlässigkeit (LBF)), the Institute for Internal Combustion Engines and Powertrain Systems (Institut für Verbrennungskraftmaschinen und Fahrzeugantriebe (VKM) at the Technical University of Darmstadt and the companies CuroCon GmbH and OSWALD Elektromotoren GmbH. The project is funded through the Federal Ministry for Economic Affairs and Energy (BMWi) and will run from 01/01/2016 to 12/31/2018.

2 The kingpin connects the tractor to the trailer.

3 Schematic presentation of the thin film system.