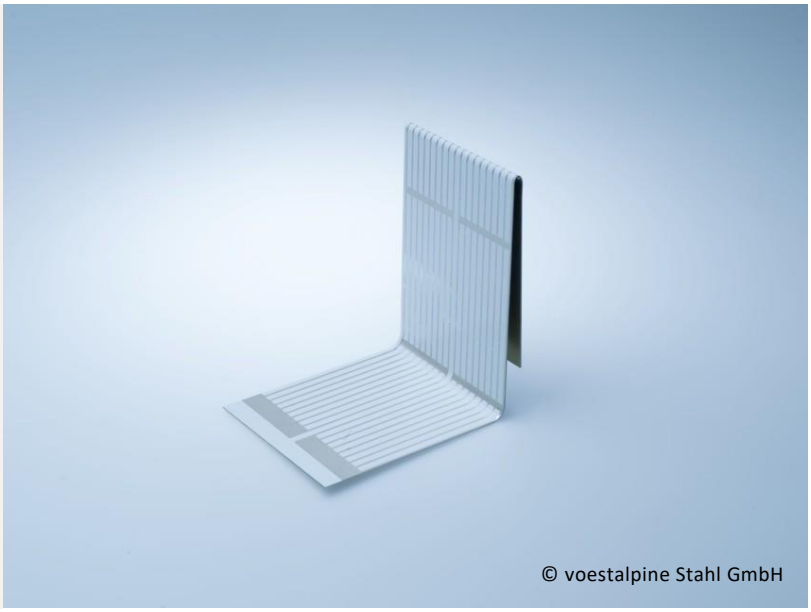
SUCCESS STORY

LCM -
K2-Center for
Symbiotic Mechtronics

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Centre K2

Type of project: MFP 3.1 Integrated and Embedded Sensors, smart steel, 2022–2026



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TAILORMADE FUNCTIONAL STEEL: «INTELLIGENT» SHEET STEEL

REAL-TIME CAPABLE SENSORS AND ACTUATORS DIRECTLY EMBEDDED IN SHEET STEEL DETECTS LOADIND AND KEEPS FOOD WARM

Sheet steel that is capable of detecting the loading of shelves or keeps your lunch warm? The intelligent steel sheet “tailormade functional steel” (tfs) by voestalpine Stahl GmbH makes it possible.

voestalpine Stahl GmbH in cooperation with the K2-Center for Symbiotic Mechatronics managed to embed functionality directly into sheet steel without the need for additional external sensors or actuators. After applying a multi-layer isolation coating, the sheet is cut to the desired size and shape. Conductor paths are then screen printed onto the surface. The advantages: A significant reduction in size and potentially also in processing steps. Furthermore, the virtually invisible circuit paths facilitate completely new design possibilities.

For the first time, tfs technology allows the ‘digitalization’ of the raw material steel as a ‘smart product’ by enabling the acquisition of data directly on the steel surface and the transmission in real time. Innovative digital applications can be integrated directly into a product without further processing steps: Door openers operated by touching or heatable shelves that can detect whether they are loaded or free are only examples.

Conducting areas and shapes are customized for the application’s functional necessities such as the required heating power. Multiple functions can be combined on a single panel, and the mechanical stability of steel and the high plasticity of the coating allow the realization of complex structures.

Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

Federal Ministry
Republic of Austria
Digital and Economic Affairs

Version 01/2020

The maximal dimensions of the printing area are currently 1,250 x 2,500 mm, and multiple components of smaller size can be designed and realized on a single panel.

Complex challenges for the K2-Center LCM

An important factor for success in the development was the constructive cooperation in the framework of the K2 COMET program between the company partner voestalpine Stahl GmbH and the research partners LCM and the Institute for Microelectronics and Microsensors at the Johannes Kepler University Linz (IME).

The focus at IME was on the development of technologies and the research on the integration of printed sensors in the organic protective layer on steel sheets. For this purpose, newly developed functional materials were employed that are in principle a composite of nano-particles and polymers. Challenges in the implementation of different sensor structures were ensuring mechanical robustness against processing steps such as deep drawing, and the fact that steel sheets are themselves electrically conductive. LCM was responsible for the connection of the intelligent steel sheet with its environment and the analysis of sensor data in real time. Contacting and interfacing the printed conductors proved particularly challenging due to space limitations and the different material properties. As a smart and space-efficient solution a circuit was developed that is attachable directly to the edge of the sheet. The measured sensor data is pre-processed and transmitted to a dedicated software that is also capable of feeding back sensor parameters necessary for the operation.

Impact and effects

In various prototypes, tfs technology has already managed to show its potential to revolutionize whole industrial sectors.

Used as a control element, this technology has the potential for innovative operating concepts and a significant improvement in device usability.

Currently, a maximum of 300,000 tfs parts can be produced per year. For the coming 3–5 years, voestalpine plans to increase the capacity to several million.

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Project partners

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- Johannes Kepler University Linz, Institute for Microelectronics and Microsensors

This success story was provided by the consortium leader and by the mentioned project partners for the purpose of being published on the FFG website. The K2-Center for Symbiotic Mechatronics is a COMET Centre within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMDW, and the province of Upper Austria. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet