PROZESS SIGNATUREN
TRANSREGIONALER SONDERFORSCHUNGSBEREICH 136

Universität Bremen · RWTH AACHEN UNIVERSITY · OKLAHOMA STATE UNIVERSITY

IMSAS Institut für Mikrosensoren, -aktoren und -systeme · IWT Leibniz-Institut für Werkstofforientierte Technologien · ifam Institut für Angewandte Mechanik

C04: Measurement of Material Load using Integrated Sensors

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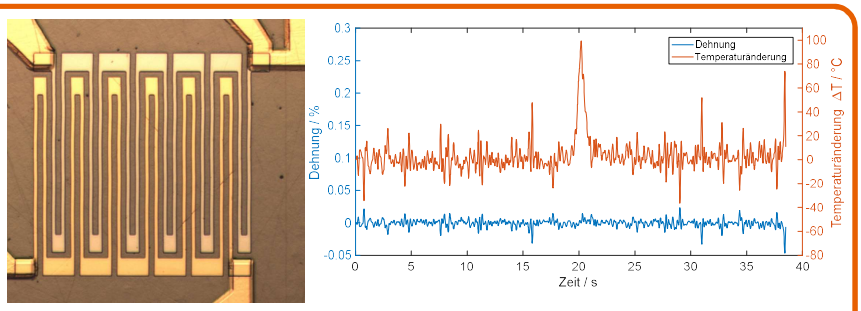
Objective and approach

Project C04 investigates different methods for workpiece-sided, high-resolution measurement of material loads such as strain and temperature in machining processes. In order tu fulfill this aim, microsensors are developed, characterised and integrated into workpieces in a way that allows subsurface, workpiece-sided measurement of material load in various machining processes. Investigation is focused on the fabrication of suitable sensors on steel, reliability of measurement methods as well as interpretation of measurement results.

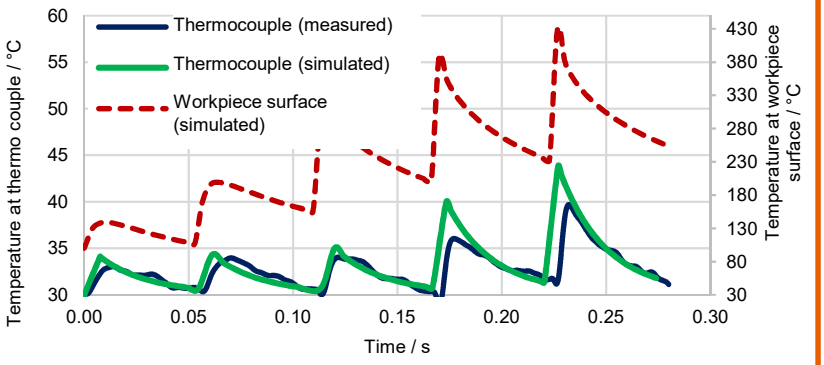
Current state of knowledge (May 2021)

In the second funding period, improved strain gauges, that have been integrated in workpieces, allowed enhanced measurement of material loads in various machining processes. In the top picture, a novel 2-metal strain gauge is depicted, that was used for the simultaneous measurement of strain and temperature at the workpiece surface during grinding. The measurement method is very promising, however, it requires a very good calibration as well as stability of the sensor.

An approach for temperature measurement using thermocouple, which had already been tested in the first funding period, was improved and allowed fast, high-resolution measurement of temperature evolvement at the surface of a workpiece. The bottom picture shows an examplary result from temperature measurement in precision cutting, in which the temperature evolution during every single cut is visible.



Simultaneous measurement of strain and temperature during grinding



Temperature measurement of single cuts during precision cutting

Conclusion and further procedure

Promising concepts and sensors for the measurement of material loads in various machining processes have been developed and tested. However, the measured data often times may not be used directly as quantity for material loads for various reasons such as the unclear influence of adhesive layers or insufficient stability of the sensors during measurement.

The project C04 will be terminated after the second funding period at the end of 2021.

Publications

Gräbner, D.; Dumstorff, G.; Lang, W.: Simultaneous Measurement of Strain and Temperature with two Resistive Strain Gauges made from Different Materials, Procedia Manufacturing (2018), 10.1016/j.promfg.2018.06.030

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Sarma, M.; Borchers, F.; Dumstorff, G.; Heinzel, C; Lang, W.: Measuring strain during a cylindrical grinding process using embedded sensors in a workpiece, J. Sens. Sens. Syst., 6, 331–340 (2017), 10.5194/jsss-6-331-2017

Dumstorff, G.; Sarma, M.; Reimers, M.; Kolkwitz, B.; Brinksmeier, E.; Heinzel, C.; Lang, W.: Steel integrated thin film sensors for characterizing grinding processes, Sensors and Actuators A 242 , S. 203-209 (2016), 10.1016/j.sna.2016.03.014