

Press Release 01/2017

Safety First

Measurement of pre-tensioning forces in screw connections

CiS Research Institute is currently developing a new silicon-based MEMS sensor to verify safety-related screw connections. Such special screws are used in mechanical engineering, conveyor technology and wind turbines, e.g.

The new sensor is applied to the screw head and measures its deformation caused by the screw pre-tensioning force. Not to be confused with the torque, the screw pre-tensioning force affects the parts to be connected between the thread and the screw head. It causes an elastic deformation in all parts of the screw. At the screw head, this deformation is quite easy to measure. Up to now the strain on the screw could only be determined by measuring its length or attaching strain gauges at the screw shaft. These solutions lend themselves specifically to the evaluation of single screws. The MEMS sensor developed by CiS Research Institute consists of four piezo-resistive, strain-sensitive measurement resistors which are switched to a Wheatstone bridge. The active surface without the electrical connections amounts to no more than $(200 \times 200) \mu\text{m}^2$ with a thickness of $10 \mu\text{m}$ (fig. 1). The sensor is joined to the screw head using glass solder. A FEM-analysis determined the most suitable position on the screw head (fig. 2).

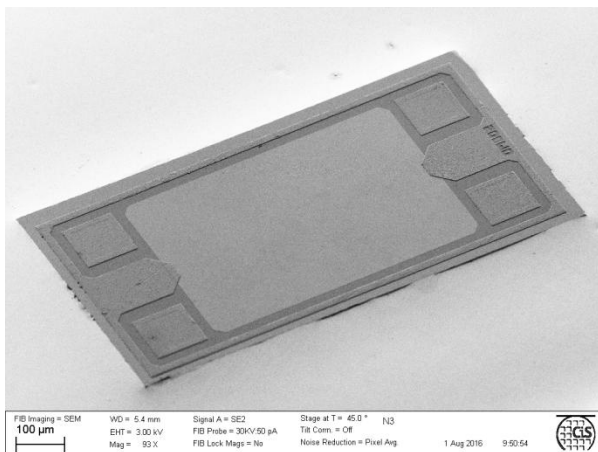


Fig. 1: Silicon strain gauge

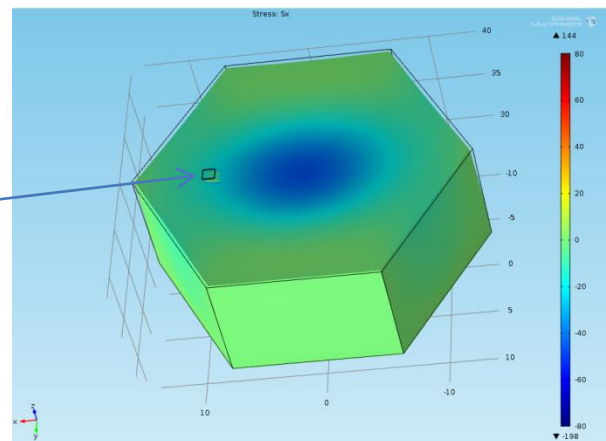


Fig. 2: Simulation of the preload force acting on the screw head

The pre-tensioning force can be measured either directly during the tightening process of the screw or contactless by means of an added RFID transponder, for safety-related monitoring of screw connections.

This new sensor technology enables the user to improve reliability and safety of the technical system, while saving material and cost at the same time.



Forschungsinstitut
für **Mikrosensorik** GmbH

Hanover Fair, 24-28 April 2017, Hanover, hall 4, booth F34
SMT Hybrid Packaging, 16-18 May 2017, Nuremberg, hall 4A, booth 318B
SENSOR+TEST, 30 May - 1 June 2017, Nuremberg, hall 1, booth 1-150

About CiS Forschungsinstitut für Mikrosensorik GmbH

CiS Research Institute for Micro Sensors GmbH is a leading R & D provider in the fields of optical, micromechanical and piezoresistive sensors as well as silicon detectors. It employs more than 100 employees and supports companies in the development of customized solutions in the fields of sensor and microsystem technology and manufactures these in small batches. Basis is the silicon technology with the specialties: 3D structuring, stacking technologies and double-sided wafer processing.

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