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### **Title:**

Automated Sensing Systems Based on Printed Strain Sensors for Monitoring of Civil Engineering Structures

### **Abstract:**

With the ever-growing trend toward urbanization, civil infrastructure is expanding rapidly around the world. However, the new constructions and gradual deterioration of those already existing, especially bridges, give rise to concerns about their proper maintenance. Therefore, to improve safety and drive down maintenance costs of civil engineering structures, there is a need for sensing systems capable of reliable and automated monitoring. To address this problem, this study aimed at the development and evaluation of screen-printed strain sensors for applications in structural health monitoring (SHM). The sensors were arranged into a form of an array printed onto a flexible substrate. Such prepared devices were integrated with a dedicated wireless data acquisition system which enables remote and automated measurements under real-life conditions. The sensing system was deployed on various types of civil engineering structures (bridges and a gravity dam) for a few-months-long operation. The use of the sensor arrays relies on comparative analysis of measured output signals from all sensors in the array, looking for strain anomalies, which are early damage indicators. Besides the capability of the developed sensors for damage detection, fundamental studies on strain sensitivity, durability, long-term stability, and sensitivity to temperature changes were carried out. The results show that printed sensors incorporated into

automated data acquisition systems can be used as complementary sensing systems to those already existing within the framework of SHM. This indicates the potential new practical application area for the printed strain sensors in monitoring civil engineering structures.

### **Biography:**

Daniel Zymelka is a Research Scientist at the National Institute of Advanced Industrial Science and Technology (AIST), Japan. He received his degree in Materials Science from the Jagiellonian University (Poland) in 2008, and his Ph.D. from Ecole des Mines de Saint-Étienne (France) in 2012. In 2011 he joined the Centre of Microelectronics in Provence (France), where he started his research on selective sintering methods for applications in flexible printed electronics. In 2015 he joined AIST and initiated research into the development of networked sensing systems based on printed electronics for applications in structural health monitoring. He currently focuses on additive fabrication methods and the development of new sensors using printed stretchable electronics.