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Prof. Dr. Paul Motzki

Direktor Smarte Materialsysteme,
Professur Smarte Materialsysteme für innovative Produktion

ZeMA

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The Smart Factory – Efficient and Sustainable Production via Shape Memory Alloy Systems

Smart or multifunctional materials change their properties as a result of external stimuli such as electric fields or temperature and thus form the basis of innovative drive systems. Smart metals such as "shape memory alloys" (SMA) act as artificial muscles and are simultaneously their own state sensor or condition monitor (so-called "self-sensing") [1]. For the production of the future, these materials will be used to create intelligent and energy-efficient systems such as compressed air-free gripping and handling systems [2] or bio-inspired soft robotic structures[3]. Eliminating compressed air in production is a crucial factor for cutting down energy consumption, guaranteeing highest air quality and reducing noise. The replacement of pneumatic systems by intelligent electrified drives is key for the digitalization of production and thus competitiveness on the global market. The presentation will give an overview of previous research and development work on SMA-driven gripping and handling systems in production applications as well as a perspective for the future with a focus on sustainability and energy efficiency.

[1] P. Motzki, A. Bucht, K. Pagel, T. Mäder, and S. Seelecke, "Thermische Formgedächtnislegierungen," in Smart Materials - Eigenschaften und Einsatzpotenziale, 1st ed., H. Böse, Ed. Würzburg: Vogel Communications Group, 2023, pp. 89–118.
[2] P. Motzki, F. Khelfa, L. Zimmer, M. Schmidt, and S. Seelecke, "Design and Validation of a Reconfigurable Robotic End-effector Based on Shape Memory Alloys," IEEE/ASME Trans. Mechatronics, vol. 24, no. 1, pp. 293–303, 2019.
[3] P. Motzki and S. Seelecke, "Industrial Applications for Shape Memory Alloys," in Encyclopedia of Smart Materials, A.-G. Olabi, Ed. Elsevier, 2022, pp. 254–266.