BoKoMaT

24.09. – 25.09.
2025

_9

Dr. Alexander Paulsen

Senior Engineer

Ingpuls GmbH

Tailoring the functional properties of NiTi shape memory alloy actuator wires

Binary NiTi shape memory alloys (SMA) are widely used for actuator solutions in different applications e.g. robotics and automotive industry. Usually such actuation tasks can be realized using solenoids or dc motors, which in some cases suffer from larger installation spaces and noise pollution produced during the actuation cycle. However, shape memory materials for automotive applications must fulfill a lot of challenging requirements, like a wide temperature range of operation, good functional stability, and sufficient structural endurance. In addition, many of these types of applications require short switchback times while operating without creating noise, which makes the choice/design of an actuator more difficult. The activation of SMA in actuation applications is usually performed by joule heating. The later product's performance is strongly dependent on the material's behavior which is controlled by the material's microstructure resulting from the manufacturing process. In this study we present results for thin wires (< 0,1 mm) and different material states produced and characterized in our laboratory, addressing the most critical requirements listed above. The results show that different material states with strongly different performances can be produced by controlling the manufacturing process and the postprocessing of the binary NiTi wire material. The performance of different material states produced on large scale equipment is characterized by an inhouse built test rig and climate chamber measurements. Transformation temperatures at different loads and fatigue tests at application related loads are presented in this study. The main results show that different requirements for the functional performance can be tailored by the control of the manufacturing process and the later postprocessing of thin wire SMAs.

Dr. A. Paulsen, S. Wehrenfennig, Dr. Ch. Großmann, Dr. A. Kortmann, Dr. B. Maaß