Experimental and numerical study on inherent sensory characteristics of piezoceramic micro parts during joining by forming in metal sheets

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ABSTRACT

A new approach for producing intelligent lightweight materials is the integration of prefabricated batches of piezoceramic micro parts in local microstructured metal sheets by the joining process by forming [1]. In this way, semi-finished metal sheets with sensor and actuator functions can be produced in high-volume production. In further forming steps, these semi-finished products can be formed into complex 3D structural parts, which is not readily possible with conventional piezoelectric patch transducers. Ensuring the component function of the piezoceramic parts in the form of parallel interconnected lead zirconate titanate (PZT) fibers is a key aspect during the forming process. Previous investigations have already shown at single PZT fibers that the inherent sensor characteristics can be used for in-process monitoring by impedance spectroscopy during the forming process [2].

This paper deals with the electromechanical characterization of the complete batch of interconnected PZT fibers before, during and after the joining process. For this purpose, experimental tests are carried out using fabricated test samples and supplemented by numerical studies. Integrated fibers are visually inspected for cracks and fractures as well as checked for their functionality. Additional tests determine the load limits of the fibers by incrementally increasing the forming force until the impedance signal fails. Based on the gained findings from the experiments and simulation the state of the interconnected PZT fibers during the joining process can be specifically controlled according to the target functionality and a fiber overload is avoided.

REFERENCES

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