BioForm

Biologization of paraffin wax actuators produced by forming technology

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Department	Functional and Composite Structures
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Abstract

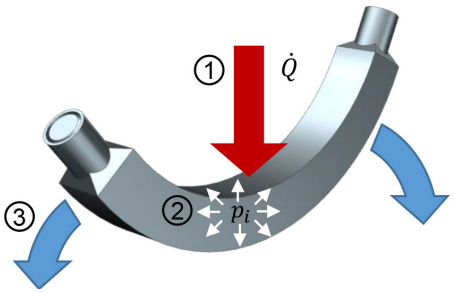
The research project aims to transfer the biological principles of stomatal movement to technical applications, in particular to phase change actuators. These are to be designed with the help of numerical studies and demonstrators. The aim is to create powerful actuators with stomatal-like operating principles, e.g. to enable self-regulating systems. The results of a comprehensive parameter study in the numerical simulations set up suggest significant actuating movements over several load cycles. A manufacturing line was developed and prototypes that successfully apply the working pressure were produced on it. Further optimization of the production technology is still required before practical implementation.

Project description

The research project aims to transfer the stomatal movements of plants to technical actuators, in particular using paraffine wax. The special property of paraffine wax to expand when heated is utilized. The aim is to develop a thermally activated actuator that performs similar movements to stomata. Numerical studies will be used to investigate the principles of stomatal movement and design guidelines will be developed to determine the optimal geometry parameters of the actuator. A demonstrator will then be developed and manufactured, taking into account practical challenges such as the sealing of the housing. The demonstrators will be characterized in order to validate the actuator concept. The knowledge gained will in turn contribute to the improvement of the model. Finally, possibilities for utilizing the results, such as safety concepts in temperature management, will be developed.

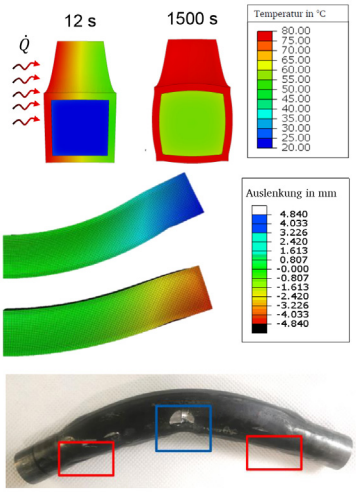
Results

The current research results show that the developed phase change actuator has the potential to work with relatively small strokes of maximum 3-5 mm and forces in the range of technical applications. Simulations show that the actuator is able to reset itself after cyclic loading and to move again when reactivated. The practical production of the actuator body shell was successful. During the final bending, however, dents appeared in the housing. The resulting prototypes were unable to perform the expected actuating movement and exhibited deformations in the area of the dents. Although concepts were developed to compensate for the dents, the measures had not yet been implemented at the end of the project. The results can serve as a basis for further research work.



[1] Conceptual idea of the actuator: The targeted heat input $\dot{Q}$ (1) results in a pressure increase p inside the actuator (2), which implies a positioning movement (3)

[2] Illustration of the numerical operating principle and a resulting prototype, critical area highlighted



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