INSTITUTE OF FLUID–FLOW MACHINERY

Polish Academy of Sciences

BOOK OF ABSTRACTS:
14th WDZYDZEANUM CONFERENCE ON FLUID–SOLID INTERACTION

WDZYDZE LANDSCAPE PARK, POLAND

30.08 – 3.09.2026

co-organizers

University of Warmia and Mazury in Olsztyn

Institute of Fundamental Technological Research, Polish Academy of Sciences

Smart microactuators based on shape memory polymers

Inteligentne mikro-siłowniki na bazie polimerów z pamięcią kształtu

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Abstract

Key shape memory parameters for the innovative material - Shape Memory Polymer (SMP) - Shape fixity R_f and Shape recovery R_r - were determined with high accuracy in a thermomechanical loading program conducted in a modified thermal chamber of the Instron testing machine. Figure 1 presents the procedure scheme and the results obtained for an Anycubic resin specimen with an exposure time of 2 s per layer. The results indicate a shape fixity of ≈ 86% and a shape recovery of ≈ 79%, confirming the good shape memory performance of the investigated polymer.

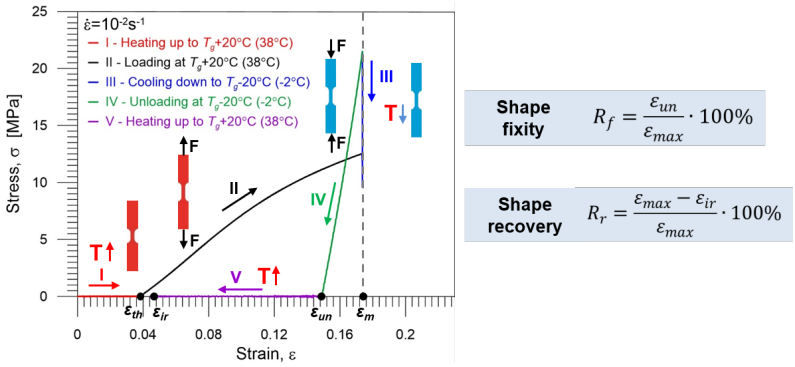

Fig. 1. Stress-strain curves obtained for shape memory photopolymer during the thermomechanical loading program.

Micro-actuators were designed and fabricated using additive manufacturing technologies. Different exposure times were applied during the printing process to obtain devices with varying material responses. This approach allows the production of components with different degrees of polymerization by applying different exposure times to selected regions of the photopolymer. As a result, programmed shape changes can be triggered by stepwise heating to various temperatures. The enhanced functionality of SMP-based actuators enables their miniaturization, which is essential for applications in robotics and biomedical engineering.

Acknowledgements: The research has been supported by the NCN - Grant UMO-2024/53/B/ST8/03931 and the KMM-VIN Research Fellowship Programme (16th Call).