Shape memory effects in multi-phase semi-crystalline networks: from phenomenological modeling to 4D printing

Matteo Arricca , Nicoletta Inverardi , Lorenzo Bonetti , Daniele Natali , Stefano Pandini , Maurizio Toselli , Massimo Messori , and Giulia Scalet*†[1]

[1]Department of Civil Engineering and Architecture, University of Pavia (UNIPV) – via Ferrata 3, 27100 Pavia, Italy

Abstract

Multi-phase semi-crystalline polymer networks may exhibit both the one-way and two-way shape-memory effects, therefore representing an appealing material for numerous applications. The present work aims to propose a general framework for the finite strain continuum phenomenological modeling of the complex thermo-mechanical and shape-memory behavior of such systems. Model capabilities are then validated against experimental data on different homopolymer and copolymer networks, giving new insights on material behavior. Finally, a novel approach for the additive manufacturing of such systems via extrusion-based 4D printing is briefly presented. A discussion on the process parameters and on their effect on material behavior is provided, together with representative application examples. *Acknowledgments. This work was funded by the European Union ERC CoDe4Bio Grant ID 101039467. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Council. Neither the European Union nor the granting authority can be held responsible for them.*

*Speaker

†Corresponding author: giulia.scalet@unipv.it