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MECHANICS OF SOFT, MULTIFUNCTIONAL MATERIALS: EXPERIMENT, MODELING AND SIMULATION

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MOKARRAM HOSSAIN*, DANIEL GARCIA-GONZALEZ†, RUIKE ZHAO §

* Zienkiewicz Centre, Swansea University
Bay Campus, Swansea, United Kingdom
mokarram.hossain@swansea.ac.uk, https://www.swansea.ac.uk/staff/engineering/m.hossain/

† Department of Continuum Mechanics, Universidad Carlos III de Madrid, Madrid
Avenida de la Universidad 30, Leganes, Madrid, 28911, Spain
danigarc@ing.uc3m.es, https://www.multibiostructures.com/

§ Soft Intelligent Materials Laboratory, Stanford University,
CA, USA
rrzhao@stanford.edu, https://zhaor.engineering.osu.edu/

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ABSTRACT

In the last decade, we have been observing an upsurge in research and development of soft, responsive materials that react mechanically to applied non-mechanical stimuli. These external stimuli could be magnetic or electric field, pH, temperature, humidity, light and combinations of any of them. One of the most promising features of these materials is their ability to undergo large deformations upon the (remote) application of active fields. Their multifunctional properties make them outstanding candidates for innovative technical applications ranging from large-displacement actuators over smart sensing devices to synthetic soft tissues in flexible electronics. Most of the smart materials have unique microstructures which can be tuned/optimized to further enhance their properties. In case of magneto- and electro-active composites, these are usually composed of a soft matrix and embedded inclusions. From a theoretical and computational viewpoint, this calls for the development of homogenization schemes to help at conceptualizing customized composite's effective properties. Moreover, recent advancements in additive manufacturing (3D printing) provide ample opportunities to intricately design these materials from the micro and nanoscale to “program” their macrostructural response. At the same time, the advance of experimental techniques allowing for precise and reliable validation and testing is paramount.

Fueled by the aforementioned advances, novel multifunctional structures are designed in the form of thin and slender components with the potential to undergo structural instabilities (i.e., buckling) in certain loading ranges. The resulting phenomena could, for example, be harnessed to arrive at very large deformations under rather small applied fields, making

materials ready for even more efficient actuation and sensing purposes. The goal of this minisymposium is to bring together researchers from experiment, modeling and simulation in order to discuss recent advancements and new directions in the field. Topics of interest include:

- Electro- magneto-, light-active elastomers
- Responsive gels (hydrogels, ionic polymers, …)
- Liquid crystal elastomers and gels
- Experimental testing and validation
- Constitutive modeling and numerical simulation
- Multiscale approaches and homogenization
- 4D printing of soft smart materials
- Material and structural instabilities
- Materials design of soft solids

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