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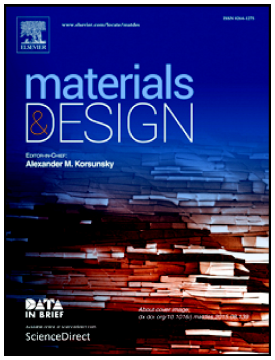

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Functional properties of silicone/ethanol soft-actuator composites

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Abstract

In the present work, we assess functional properties of silicone/ethanol elastomer composites, recently suggested by us as a novel approach to soft actuation. Our approach allows replacement of massive actuation solutions by self-contained composite material, thus making its detailed characterization extremely important. Here, we describe the composite actuation mechanism using microstructural, thermal and compositional analysis of the material comprising of 0−20 vol.% ethanol. As a part of our investigation, we also performed mechanical testing aimed at determining the optimal composition, force and strain characteristics for soft actuation. Specifically, we examined the material performance in different soft actuation scenarios pertinent to the soft robotics applications, namely unidirectional piston-like actuator, and radially expanding McKibben artificial muscle. The results were compared in terms of the maximal force and strain developed in the linear portion of the force/time and strain/time scale. The effects of sample size and internal temperature on the mechanical properties of the material were also investigated. Based on the characterization findings, we formulated operational recommendations for utilizing the composites as soft actuators, and drew directions for the further research.

Keywords: microstructure; mechanical properties; thermal analysis; silicone rubber; ethanol; soft actuator

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