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Characterization of Hydrogel Curing Methods for Manufacturability

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ABSTRACT

In the field of soft robotics, hydrogels possess material properties that allow them to function as both soft strain sensors and dielectric elastomer actuators. However, there is still much that needs to be understood about the curing process of hydrogels and the resulting material characteristics before manufacturing these devices can be accomplished. In this study, we investigated the effect of curing time and sample volume on the as-cured material properties of acrylamide-based hydrogels hydrated with lithium and magnesium chloride salt solutions. Samples were cured at room temperature, 60° C and 100° C, and the resulting changes in mechanical stiffness and rehydration rate were measured. Uncured hydrogel was also placed in drops between 1 µL and .5mL to determine the response of curing time to variations in volume. We found that stiffness decreases with increasing curing temperature. We also found that uncured hydrogel will not spontaneously cure when placed in volumes smaller than 20 µL unless placed at elevated temperature. These experiments show that hydrogels have material properties and curing times that can be tuned depending on the needs of the manufacturing process, and that the conductive hydrogels created retain their required functionality after prolonged use at ambient temperatures.

KEYWORDS

Hydrogel, dielectric elastomer, strain gauge, curing process, soft robotics