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# Shape memory polymer based self-healing syntactic foam: 3-D confined thermomechanical characterization

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## Abstract

In this study, the thermomechanical behavior of a shape memory polymer (SMP) based syntactic foam under three-dimensional (3-D) confinement was investigated through strain-controlled programming and fully confined shape recovery tests. The 3-D confinement was created by encasing the foam in circular confining tubes and subjecting the foam cylinder to uniaxial compression. The parameters investigated included two programming temperatures, three types of confining tubes with varying lateral confinements, three prestrain levels, and one fully-confined recovery condition. A three-layer plane-stress analytical model was also developed to estimate the volume change of the specimen by prestressing. It is found that the stress recovery ratio is the highest with rubber liner and the recovered stress is the highest with nylon liner. The stress recovered in the foam specimen which is confined by the nylon liner is as high as

26Â MPa, making it possible as actuators. While volume reduction during programming is the key for the foam to self-close cracks, the volume reduction must be within a certain limit; otherwise, the foam loses its shape memory functionality.

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## Keywords

A. Functional composites; A. Polymer; A. Smart material; B. Thermomechanical property; Self-healing

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