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**A facile method to fabricate polyurethane based graphene foams/epoxy/carbon nanotubes
composite for electro-active shape memory application**

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Abstract

Shape memory polymers (SMPs) have attracted the attention of both the industry and academia due to the fact that they can deform and fix into a temporary shape, and recover their permanent, original shape upon exposure to an external stimulus. In this work we propose a novel, shape memory three-dimensional (3D) polyurethane-based (PU) graphene foam (PGF)/epoxy/carbon nanotubes (PGEC) composite. The composite uses epoxy resin (EP) as matrix, a low-density (about 0.030 g/cm³), highly porous, commercially available PU sponges as the scaffold, and graphene and carbon nanotubes (CNTs) as conductive network. The proposed PGEC composites demonstrate excellent conductivity and could be triggered within 150 seconds by applying an electric field of approximately 1.43 V mm⁻¹. The proposed SMP composite material is simple and fast to manufacture, operational, and low cost.

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