3D Shape-Reconfigurable Electronics Using Liquid Crystalline Polymer Composites

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The shape reconfiguration has been received rapidly growing interests in electronics for diverse functionality. For shape reconfigurable electronics, programmable materials, e.g. liquid crystalline polymers, are essential to be applied as platforms for untethered 3D morphing. Herein, we present azobenzene-functionalized liquid crystalline polymer networks bilayered with patterned reduced graphene oxide(azo-LCN/rGO). The high electrical conductivity (380 S cm^{-1}) of the rGO pattern is successfully transferred to azo-LCN with 5 times enhanced modulus (E′=6.4 GPa) than neat owing to π-π stacking between rGO and azo-LCN driven high compatibility. In addition, the azo-LCN/rGO demonstrates enhanced photo-chemically/-thermally driven actuation under UV, NIR, solar-ray, and flame by overcoming the trade-off between actuation and modulus. Finally, the kirigami is applied to azo-LCN/rGO for diverse shape morphing beyond intrinsic strain capacity. Under hybrid type stimuli consisted with mechanical tension and UV, the kirigami engineered azo-LCN/rGO demonstrates 3D shape-morphing to human spine-like shape with up to 70 % of strain without deterioration of electrical performance.