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Graphene Oxide Aerogel Metamaterials for future Human machine interface

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ABSTRACT

Graphene aerogels hold huge promises in developing high performance pressure sensors for future human machine interface, due to their highly ordered microstructure and conductive network. However, the bottleneck to their application is the limited strain sensing range caused by intrinsic stiff honeycomb-like structure. Herein, an anisotropic crosslinked chitosan and reduced graphene oxide (CCS-rGO) aerogel metamaterial with a buckling network is realized for the first time, by reconfiguring the microstructure from honeycomb to buckling structure on the cross-section plane, *via* simple freeze-casting and heating/post-crosslinking strategies. The reconfigured CCS-rGO aerogel shows hyperelasticity with extraordinary durability - no obvious structural damage after 20,000 load-unload cycles under a directional compressive strain up to 0.7. The novel CCS-rGO aerogels based conceptual pressure sensors exhibit an ultrahigh sensitivity of 121.45 kPa^{-1}, an unprecedent sensing range (maximum compressive stress of 146.7 kPa, peak directional compressive strain of 0.95), and robust mechanical and electrical performances. The aerogel metamaterials sensors are assembled and demonstrated to monitor human motions, control robotic hand and even integrated in a flexible electrical keyboard to play music. The functionalities enabled by CCS-rGO may open a wide application potential in future human machine interface.