Hierarchical Reduced Graphene Oxide Ridges: Preparation, Characterization and Application for Flexible Electronics

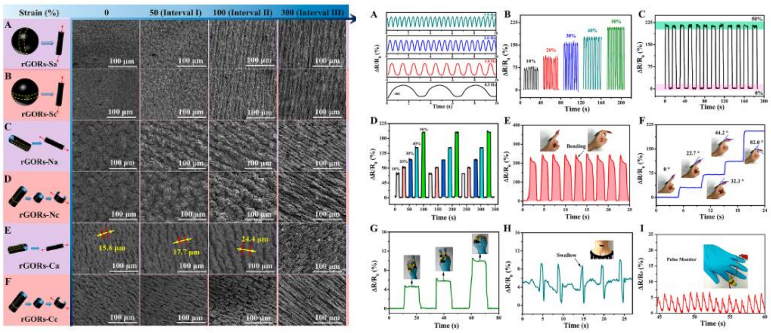
Zengyong Chu*, Yinlong Tan, Jia Song

* College of Liberal Arts and Sciences, National University of Defense Technology, Changsha 410073, China (chuzy@nudt.edu.cn)

Abstract

Recently, flexible and wearable devices are increasingly in demand and graphene has been widely used due to its exceptional chemical, mechanical and electrical properties. Building complex buckling patterns of graphene is an essential strategy to increase its flexible and stretchable properties. Herein, a facile dimensionally controlled four-dimensional (4D) shrinking method was proposed to generate hierarchical reduced graphene oxide (rGO) buckling patterns on curved substrates mimicking different parts of the uniforms.

The reduced graphene oxide ridges (rGORs) generated on the spherical substrate seem isotropic, while those generated on the cylindrical substrate are obviously more hierarchical or oriented, especially when the cylindrical substrate are shrinking via two steps. The sensitivity of rGORs along the axial direction is much higher than those along the circumferential direction. The flexible rGORs-based strain sensors can be used to detect both large and subtle human motions and activities by achieving high sensitivity (maximum gauge factor up to 48), high unidirectional stretchability (300−530%), and ultrahigh areal stretchability (up to 2690%). Excellent durability was also demonstrated for human motion monitoring with resistance to hand rubbing, ultrasonic cleaning, machine washing, and chemical immersion.



References

[1] Tan, Y.L.; Hu, B.R.; Chu*, Z.Y.; Wu*, W.J. Bioinspired Superhydrophobic Papillae with Tunable Adhesive Force and Ultralarge Liquid Capacity for Microdroplet Manipulation. Advanced Functional Materials, 1900266, 2019.

[2] Tan, Y.L.; Chu*, Z.Y.; Jiang, Z.H.; Hu, T.J.; Li, G.Y.; Song, J. Gyrification-Inspired Highly Convoluted Graphene Oxide Patterns for Ultralarge Deforming Actuators. ACS Nano, Vol. 11, pp.6843-6852, 2017.

[3] Song, J.; Tan, Y.L.; Chu*, Z.Y.; Xiao, M.; Li, G.Y.; Jiang, Z.H.; Wang, J.; Hu, T.J. Hierarchical Reduced Graphene Oxide Ridges for Stretchable, Wearable, and Washable Strain Sensors. ACS Applied Materials & Interfaces, Vol. 11, pp.1283–1293, 2019.