Soft Actuators based on Graphene and 2D Materials

IL-KWON OH[1]

[1] Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon 34141, South Korea
ikoh@kaist.ac.kr

Abstract

Ionic soft actuators, which exhibit large mechanical deformations under low electrical stimuli, have been attracting attention in recent years with the advent of soft and wearable electronics. However, a key challenge for making high-performance ionic soft actuators with large bending deformation and fast actuation speed is to develop a stretchable and flexible electrode having high electrical conductivity and electrochemical capacitance. Here, we newly report a functionally antagonistic hybrid electrode with hollow tubular graphene meshes and nitrogen-doped crumpled graphene for superior ionic soft actuators. Three-dimensionally (3D) networked and hollow tubular graphene meshes, which are grown from Nickel mesh platforms by a chemical vapor deposition method, provide high electrical conductivity and mechanically resilient functionality on whole electrode domain. On the contrary, nitrogen-doped wrinkled graphene supplies ultrahigh capacitance and stretchability, which are indispensably required for improving electrochemical activity and actuation speed in ionic soft actuators. Present results show that the functionally antagonistic hybrid electrode greatly enhances the actuation performances of ionic soft actuators, resulting in much larger bending deformation up to 620 % and 10 times faster rise time and much lower phase delay in a broad range of input frequencies. This outstanding enhancement in ionic soft actuators mostly attributes to exceptional properties and synergistic effects between hollow tubular graphene mesh and nitrogen-doped crumpled graphene, which have functionally antagonistic roles in charge transfer and charge injection, respectively.[1]

Figures

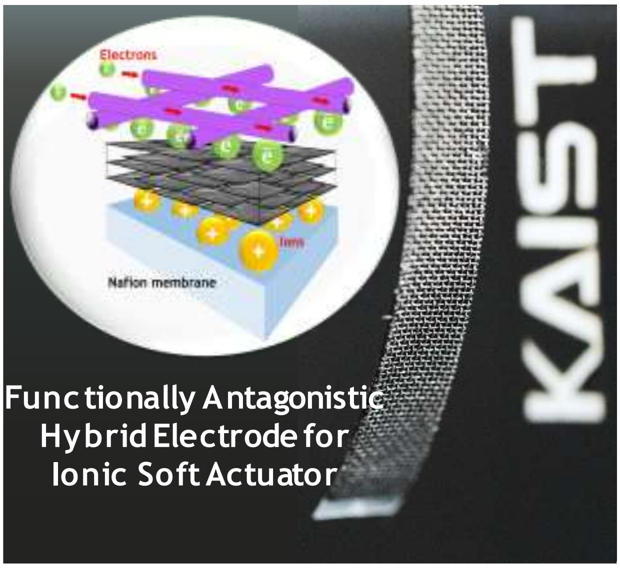

Figure 1. Functionally antagonistic hybrid electrode based on graphene mesh and nitrogen-doped graphene.

References

[1] Advanced Functional Materials, Vol. 28, Issue 5, 2018, 1705714