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Real-Time Control of Biological Motor Activity using Graphene-polymer Hybrid Bioenergy Storage Device DONG JUN LEE, KYUNG-EUN BYUN, DONG SHIN CHOI, EUNJI KIM, DAESAN KIM, Seoul National University, DAVID SEO, HEEJUN YANG, Samsung Research Park, SUNAE SEO, Sejong University, SEUNGHUN HONG, Seoul National University, HYBRID NANODEVICE LAB TEAM, SAMSUNG RESEARCH PARK TEAM — Biological motors have been drawing an attention as a key component for highly efficient nanomechanical systems. For such applications, many researchers have tried to control the activity of motor proteins through various methods such as microfluidics or UV-active compounds. However, these methods have some limitations such as the incapability of controlling local biomotor activity and a slow response rate. Herein, we developed a graphene-polymer hybrid nanostructure-based bioenergy storage device which enables the real-time control of biomotor activity. In this strategy, graphene layers functionalized with amine groups were utilized as a transparent electrode supporting the motility of biomotors. And conducting polymer patterns doped with adenosine triphosphate (ATP) were electrically deposited on the graphene and utilized for the fast release of ATP by electrical stimuli through the graphene. Such controlled release of ATP allowed us to control the motility of actin filaments propelled by myosin biomotors in real time. This strategy should enable integrated nanodevices for the real-time control of biological motors to the nanodevices, which can be a significant stepping stone toward hybrid nanomechanical systems based on motor proteins.

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