Thin Layer Graphene for Biomedical Applications

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Monolayer graphene has been widely studied for usage in nanoelectronics, nano energy, biomedics, photonics and environmental protection. In biomedical field, graphene can function as structural layer for tissue engineering, transport mechanism in drug delivery, and active layer for improving bioNEMS devices' efficiencies. Here we present our work on thin layer graphene as an active layer for improving efficiencies of a NEMS micro supercapacitor and a NEMS biosensor. We developed a vertically aligned graphene interdigital micro supercapacitor for powering biomedical implants and wearable electronics. The high energy density micro supercapacitor is intended to replace the conventional Li-Ion batteries which are troublesome when integrated into biomedical implants. Our basic MEMS interdigital micro supercapacitor has a specific power of 2.18 mW/cm^2. Vertically aligned graphene on supercapacitor's interdigital fingers increases the device's active surface area, thus capable of increasing its specific power threefold. On the other hand, in graphene based FET biosensor for detecting ADH in artificial kidney, we used monolayer graphene as an active layer. The aptamers coated graphene FET has an ADH detection sensitivity range of 1-500 pM, which threshold is sufficient for detection of ADH in artificial kidney application. The presented integration of thin layer graphene in bioNEMS devices open up possibilities of the infinite usage of graphene technology in biomedical applications.