CRIMSON PUBLISHERS
Wings to the Research

COJ Electronics & Communications

ISSN: 2640-9739

Editorial

Role of Graphene in Flexible Electronics

Garima Mittal and Kyong Y Rhee*

Department of Mechanical Engineering, Kyung Hee University, Korea

***Corresponding author:** Kyong Y Rhee, Department of Mechanical Engineering, College of Engineering, Kyung Hee University, Yongin 446-701, Korea

Submission: October 15, 2018; **Published:** October 22, 2018

Editorial

The future of electronics lies in flexible devices that are stretchable, bendable, foldable, transparent, and wearable. Sooner, currently used rigid devices will be substituted by the light-weight, convenient, and durable flexible circuits, displays and storage devices. Currently, most of the touch panels and display devices use indium tin oxide (ITO), which is transparent and conductive but have poor mechanical and chemical stability with high fabrication cost. Contrarily, flexible electronics is a new approach where electronic circuits are assembled on flexible substrates such as metal nanowires, graphene, carbon nanotubes, and conducting polymers. Along with the flexibility and stretch ability, the simultaneous excellence in mechanical and electrical performance is also desired. Mostly used conventional inorganic-based materials exhibit poor mechanical properties limiting their potential incorporation in flexible devices. However, organic-based materials are not environmentally stable. There are many 2D materials with outstanding, mechanical, electrical, and optical properties that can be proved as suitable candidates for flexible devices such as graphene, boron nitride, and transition metal dichalcogenides.

Graphene is considered as a miraculous material with the great potential to transform the world with its limitless applications. The extraordinary mechanical sustainability along with the unaffected electronic performance during rolling, bending, or stretching drew the attention of researchers for the adoption of the graphene to develop high-performance flexible and wearable devices. Graphene is highly transparent with broad optical absorption spectrum. Exhibiting remarkable mechanical properties like extremely high tensile strength, elasticity, Young's modulus, and spring constant, due to hexagonal lattice structure and strong bonds make graphene a perfect material for flexible/stretchable circuits. In flexible electronics, it is crucial that electronic properties should not be diminished during flexibility or stretching. Therefore, approaches like stacking of graphene layers, graphene-metal nanowire composites, and graphene on pre-strained substrates practiced maintaining stretch ability and electronic performance at the same time. High electron mobility (100 times higher than of Si) and charge density make flexible graphene eligible to replace other conventionally used materials for various components in flexible electronics. Despite being a wonder material and a perfect candidate for flexible electronics, graphene has some practical limitations such as the absence of an intrinsic bandgap, lower work-function (large energy barrier), and relatively high sheet resistance that hinders its application in as an electrode in electronics. Doping is an excellent technique to improve the electronic properties of the graphene-based flexible electronic devices like luminous efficiency in LEDs, the on-off ratio in switching devices, and power conversion efficiency in solar cells that manipulates the bandgap and charge conduction in devices. Substitutional doping, charge-transfer doping methods offer a new degree of freedom by doping in graphene. To introduce a finite bandgap in pristine graphene various methods such as hydrogenation, oxidation, and GNR formation are practiced [1].

Another critical issue that restrains the graphene from its commercial use in flexible electronics is the bulk production of highly conductive graphene with good crystallinity and stability. For the satisfaction of commercial realization of graphene-based devices, chemical vapor deposition is preferred. CVD-grown graphene is comparatively more promising and feasible than the other synthesis methods as it provides the ways to optimize the structure and properties of the produced graphene and produce graphene in bulk. Practically, multiple defects present in CVD grown graphene and large-area graphene are still a challenge that needs to be addressed. For further flourishment of graphene-based flexible electronics, advancement in the defect-free transfer of graphene on a desired substrate and its proper adhesion to these substrates require development. Although graphene is a highly stable material with a very large surface-to-volume ratio that helps in adhesion with various organic materials. However, weak interface with some substrates like rubber due to its porous and stretchable nature can induce a scattering effect. Hence, to deal with such issues during device fabrication, strong adhesion between graphene and substrate along with better environmental stability is required for next-generation electronics. In crux, the mature growth and fabrication technology of these graphene-based flexible electronic devices will open the doors of endless opportunities in the field of next-generation electronics. Recently, a research team from Queen's University have created the history by making a rollable touch-screen tablet inspired by the design of ancient scrolls [2]. A team from MIT has developed a technique named 'remote epitaxy' that could be used to fabricate the ultrathin flexible films on various semiconducting material by manipulating the transparency of graphene to atomic interactions [3]. In crux, the mature growth and fabrication technology of these graphene-based flexible electronic devices will open the doors of endless opportunities in the field of next-generation electronics.

References

1. Han TH, Kim H, Kwon SJ, Lee TW (2017) Graphene-based flexible electronic devices. Materials Science and Engineering R 118: 1-43.
2. Gomes A, Priyadarshana LL, Visser A, Carrascal JP, Vertegaal R (2018) Magicscroll: a rollable display device with flexible screen real estate and gestural input. Proceedings of the 20th International Conference on Human-Computer Interaction with Mobile Devices and Services.
3. Kim Y, Cruz SS, Lee K, Alawode BO, Choi C, et al. (2017) Remote epitaxy through graphene enables two-dimensional material-based layer transfer. Nature 544: 340-343.

How to cite this article: Garima M, Kyong Y R. Role of Graphene in Flexible Electronics. COJ Elec Communicat. 1(2). COJEC.000509. 2018.
DOI: 10.31031/COJEC.2018.01.000509