Graphene

General Description and Applications of Graphene

General Description

Graphene, the 2D form of carbon-based material existing as a single layer of atoms arranged in a honeycomb lattice has set the science and technology sectors alight with interest in the last decade in view of its astounding electrical and thermal properties, combined with its mechanical stiffness, strength and elasticity. Mono layer graphene with remarkable properties such as high thermal conductivity of the order of 5000 $W\ m^{-1}K^{-1}$, large specific surface area of 2630 m^2g^{-1}, high intrinsic mobility of $2\times 10^5\ cm^2\ V^{-1}\ s^{-1}$, Young's modulus of as high as 1.0 TPa, strength of as high as 130 GPa, and electrical conductivity which can surpass silver (in a defect free or nearly defect free graphene) at room temperature owed to delocalized electrons. Owning to its unique properties such as low flake resistance and good transmittance, graphene was applied in different electronic devices including the organic light emitting diodes and touch screen displays. Our Company produced graphene with a very large electrical conductivity of ~ $5*10^5$ S/m and high purity of 91% sp^2 hybridized carbon content, carbon content of >95% and extremely hydrophobic.

Graphene Applications

Graphene as filler for Multifunctional composites: Addition of graphene particles as fillers to polymers has shown to result in enhancement in physical, mechanical, thermal and chemical properties. *At the moment, among all nanomaterials, only graphene has the potential for industrial scale application since it is obtained from cheap raw material*. Moreover, *graphene content of these composites is relatively low*, with insignificant marginal costs. One application will be the matrix of composites in aircrafts to enhance structural performance, electromagnetic shielding and mitigate risks of lightning strikes.

Energy Storage Devices: Thin graphene sheets have huge specific surface area (SSA), electrical conductivity, and electrochemical stability, all required in efficient electrodes for supercapacitors/batteries: *Samsung uses graphene to improve performance and charging rate of Li-ion batteries*. Graphene can be a critical element of Green energies (solar & wind) to store energy during on-cycles to address low-predictability in energy sources. Conductive graphene-filled composites have also been used in flexible electronics.

Graphene in Bio-engineering Applications: Having anti-microbial functionality and huge SSA make graphene a great candidate in this broad field. In addition, graphene sheets, owed to their high electrical conductivity, have been used to develop fast-response bioelectric sensory devices.

Graphene in Optoelectronics: An industry that need large quantities of graphene is optoelectronics such as organic light emitting diodes (OLEDs), liquid crystal displays (LCD) and touchscreens. In this field, materials with high light transmittance (> 90%) and electrical conductivity are required, for which graphene is ideal**.** Moreover, since graphene shows high electron mobility and low light absorption, it is a great alternative for silicon cells in solar cells (photovoltaic cells) with enhanced performance and reduced costs.

Due to its remarkable properties, graphene sheets in particular the one produced by our company are applicable in many applications, as shown in Figure 2. Main market pulls of graphene are presented below.