# Graphene and its derivatives-based composites for industrial applications

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Abstract

The exceptional mechanical, thermal, electrical, and optical properties of graphene have sparked widespread interest in its potential applications across various industries. The integration of graphene and its derivatives, such as graphene oxide and reduced graphene oxide, into composite materials has emerged as a promising approach to harness their unique properties. Graphene-based composites have shown significant potential in enhancing the performance of materials used in energy storage and conversion, aerospace, automotive, biomedical, and construction applications. By leveraging the unique properties of graphene, these composites offer opportunities for innovation and advancement in various industrial sectors.

Mechanical Composites

Graphene-based mechanical composites have been developed to enhance the mechanical properties of materials such as polymers, metals, and ceramics. The addition of graphene to polymer matrices has been shown to improve their tensile strength, stiffness, and toughness. For example, graphene-reinforced polypropylene composites have been demonstrated to exhibit improved mechanical properties, making them suitable for applications in the automotive and aerospace industries. Graphene-based composites have also been explored for use in advanced composite materials for aerospace applications, where they offer improved mechanical properties, reduced weight, and enhanced durability [1].

Energy Storage Composites

Graphene-based composites have been widely investigated for energy storage applications, including batteries, supercapacitors, and fuel cells. Graphene-based electrodes have been shown to improve the performance of lithium-ion batteries, with enhanced charge/discharge rates and cycle life. Graphene-based supercapacitors have also been developed, offering improved energy density and power density. Additionally, graphene-based composites have been explored for use in fuel cells, where they offer improved catalytic activity and durability [2].

Thermal Composites

Graphene-based thermal composites have been developed for applications in thermal management and energy harvesting. Graphene-based thermal interface materials have been shown to improve the thermal conductivity of materials, making them suitable for use in electronic devices and thermal management systems. Graphene-based composites have also been explored for use in thermoelectric devices, where they offer improved thermoelectric performance and efficiency [3].

Cement Composites

Graphene based cement composites could contribute towards major improvement in the properties of concrete, including significant changes in the microstructure. Various researchers are working all over the globe regarding application of graphene-based materials in Cementous application for sustainable concrete, mortar & paste. Cement alone contributes to 8% of global $CO_2$ production, incorporation of graphene in cement composites could reduce this $CO_2$ emission by 20% at least [4].

## References

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