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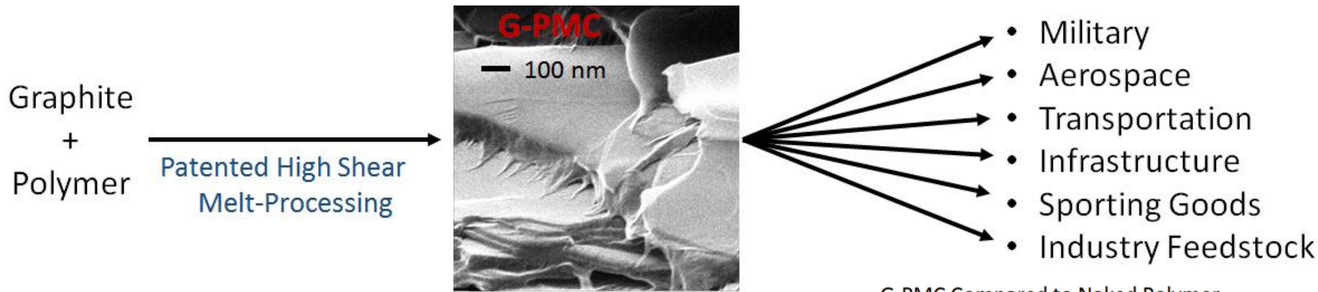
HIGH PERFORMANCE Graphene-POLYMER MATRIX COMPOSITES



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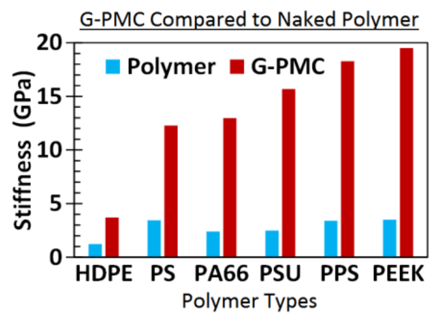
Rutgers co-inventors: Bernard Kear, Ph. D., Thomas Nosker, Ph.D, Stephen Tse Ph.D., Justin Hendrix, and Gordon Chiu, ND

Intellectual Property Status: Patents filed in US, Canada, Europe, Mexico, Brazil, Japan, South Korea, Singapore, India, and Hong Kong



Graphite exfoliated directly within a polymer matrix (G-PMC). These composites are high performance (high stiffness, high impact resistance), multifunctional, low weight, and corrosion resistant yielding a product with lower materials, operational, and logistics costs.

Innovation Summary: Researchers at Rutgers University have developed a scalable method to exfoliate graphite into graphene directly within a molten polymer. The discovery and development of this technology of covalently linking graphene-polymer matrix composites (G-PMC) has created the opportunity for the development of lightweight, high performance, next generation materials of extraordinary strength and impact resistance.

In situ exfoliation of graphite within a molten polymer provides the opportunity for very good planar-adhesion and edge-covalent bonding, which underlies the significant mechanical property enhancement for the G-PMC. Starting with graphite as the raw material significantly reduces costs, compared with graphene or carbon fibers. The polymer matrix can be varied to match the desired properties required for the material's use. These variations may also include the addition of nylons, acrylics, thermoplastic polyimides, and liquid crystal polymers.

Advantages:

- Lower material and operating costs compared to currently used carbon fiber reinforced PMCs and traditional materials
- A lightweight alternative with longer service life
- Multifunctional properties, including mechanical, thermal, electrical, and barrier properties
- Easily tunable to match specific deployment requirements
- Inherently sustainable and globally scalable

Market Applications: Military (lightweight armor, vehicles, small boats, helmets, munitions); Aerospace (UAVs); Transportation (vehicles, small boats); Infrastructure (bridges); Sporting Goods (tennis, golf, hockey, skiing); Packaging (barrier resistant layer); Feedstock for polymer industry

Potential Social and Economic Impact: G-PMCs are a direct alternative to heavier traditional materials and to current carbon fiber or glass fiber reinforced polymer matrix composites. This technology has the potential to provide a new class of materials for modern needs that are lightweight, multifunctional, low cost, corrosion resistant, easy to manufacture, and maintenance-free.

Composites resulting from this technology will not need expensive and environmentally detrimental carbon fiber production or metal forming techniques. Composite feedstocks can be tailor-made, and complex-shaped components are easily mass-produced. Nanocrystalline metal coatings can be applied to further enhance the excellent mechanical properties of G-PMCs, including stiffness, strength, and impact resistance.

Next R&D Steps:

- Optimize the composite structure for key industrial uses such as automotive door panels or frames
- Develop industrial scale production methods to be able to produce the composites to meet market demand

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