Graphene Based composites for conventional and additive manufacturing

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Abstract (Arial 10)

Graphene-based composites manufactured on a lab scale have been shown to exhibit impressive properties over unreinforced polymers. A small percentage of graphene within a polymer matrix can significantly improve its strength, stiffness and electrical conductivity, however the material remains prohibitively expensive for large-scale use as a composite reinforcement. Therefore, the concept for this project is to develop the knowledge-based processing methods required to up-scale the production of graphene and expanded graphite reinforced thermoplastic masterbatches and compounds and, ultimately, enable its industrial commercialisation in Europe. The work is focused on developing processes for large scale rapid production of graphene reinforced plastic intermediate materials, which can be integrated into current conventional and additive manufacturing processes.

Injection moulding, extrusion blow moulding and film extrusion are all well-established moulding methods for producing parts at very high throughputs. Compounds and masterbatches are commonly used in these processes, and the graphene reinforced thermoplastic compounds and masterbatches will simply fit into the existing manufacturing chain, enabling the functionality of these materials to be applied to high volume components.

Additive Manufacturing (AM) is a process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies such as machining. The biggest advantage of additive manufacturing is the flexibility in the production due to a tool free process, which also reduces the costs and the time to market of new products. Due to the layered nature of the part generation, additive manufacturing can deliver unique materials, structures and properties.

Graphene and expanded graphite based materials have been developed and optimise nanocomposite processing parameters - both for conventional processes such as injection moulding and film extrusion; and for additive manufacturing processes, including selective laser sintering and fused deposition modelling.

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References

[1] Chua Ck, Leong KF,Lim CS. Rapid Prototyping: Principles and applications.3rd Edition, World scientific. (2003)

[2] B Galindo, S Gil Alcolea, J Gómez, A Navas, A Ortega Murguialday, M Pérez Fernandez and R C Puelles. Effect of the number of layers of graphene on the electrical properties of TPU polymers. IOP Conference Series: Materials Science and Engineering Volume 64 conference 1 (2014)