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Editorial corner – a personal view
Polymer composites: Evolve towards multifunctionality or perish

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Polymer composites were initially adopted and became popular in transportation sectors (primarily and massively in aerospace, then automotive and in a lesser extent railway industry) to manufacture structural and semi-structural parts driven by their superior strength and stiffness-to-weight ratio. Such market segments, where the lighter is the better, used to be the Eldorado of textile-reinforced polymers. However emerging metal alloys and new lightweight designs allowed by additive manufacturing are likely to threaten traditional polymer composite solutions, all the more so given that their recycling remains a tricky issue.

Thus, polymer composites are destined to evolve to remain attractive and competitive. Lightweighting is no longer enough to win the race, multifunctionality becomes a crucial asset. The ability to add functionality to a composite part is nowadays significant for the performance and added-value of structural components. Self-healing, embedding sensors and actuators for structural health monitoring and adaptive response, embedded energy storage and energy harvesting, enhancement of thermal and electrical conductivity, and data-transmission within composite parts are some examples of the challenges to face.

To re-invent this class of materials, one can take advantage of new manufacturing processes (robotic automation, process hybridisation, 3D-textile reinforcement, direct composites 3D printing) and new materials – incorporating for instance nanocarbon (graphene, carbon nanotubes), metallized fibres or electroactive/conductive/piezoelectric polymer matrices into composites.

Novel versatile and scalable additive manufacturing 3D printers, dedicated to the production of thermoplastic composite parts and having unprecedented features, are currently developed for this purpose. They are based on multi-axis robots mounted on translation rails and equipped with several extruders permitting multi-materials processing; fed by standard polymer pellets, they offer great flexibility (simultaneous deposition of several thermoplastics, chopped fibre-reinforced and filled plastics, embedding of continuous fibres and possibly linear sensors) and allow manufacturing of several meters long/large components.

Competition between materials is ever tougher. Collaborations between academic and industrial players are the key to develop innovative solutions meeting the demand for composite solutions allying design freedom, lightweight, high multifunctional performance and cost-efficiency.

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