Editorial corner – a personal view

Advanced composites – when ‘imaginengineering’ meets reality...

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Fiber reinforced polymer matrix composites exhibit the potential to equally fulfil structural-mechanical and functional requirements. High-performance structures in terms of stiffness, strength and damage tolerance and a wide variety of products with specific multifunctional properties may be designed and manufactured for engineering applications.

While metallic materials may reveal high modulus and isotropic behavior, polymer matrix composites exhibit high stiffness and various degrees of anisotropic behavior. In conventional multilayer structures the ply stacking sequence plays an essential role in defining the overall macroscopic mechanical behavior. Most fiber reinforced laminates are symmetrically laid up about their mid-plane and antisymmetric laminates are rare. However, there are several exceptions where the application of anti-symmetric, ‘unbalanced’, ‘coupled’ laminates become advantageous (aeroelasticity). This inherent self-adjusting behavior can be further improved via embedding sensors and actuators for creating smart structures (morphing). Although the basic rules of laminate design are widely used by structural engineers, they are less adopted by material scientists, product designers and processing experts. Hence, there is a lack in the communication between specialists along the entire value creation chain of composites.

Owing to the inherent viscoelastic nature of polymers, the related composites show higher damping than purely elastic materials. The anisotropy and the

tailable ratio between stiffness and damping become relevant for biomechanical applications. Composite exoskeleton systems with optimized stiffness-to-damping ratio may support the locomotion of the human body during heavy work and prevent serious injuries or support the rehabilitation of the human body after medical treatments. Damping elements with high stiffness and damping ability may protect and save the human life (crash events). Finally, more joy and fun can be expected from such ‘imaginengineered’ composites when exercising complex movements and maneuvers in various sport activities (golf, surfing and sailing).

The elaboration of a comprehensive methodology involving aspects of construction, processing and manufacturing and considering the significant complexity of composite parts (ranging from passive to active smart structures), is the major challenge in future works.

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