Editorial corner – a personal view

Polymer matrix hybrid composites: The efficient way of improved performance

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The research of hybrid composites is a promising and innovative subject in the field of materials science. Hybrid systems by definition contain at least two, structurally different, units performing the same task, but which together exhibit some synergy with respect to a simple combination of these units.

What is the main difference between a commonly used micro fibre reinforced polymer composite and a hybrid one? In the former one usually two separated phases are present namely the matrix (responsible for reinforcement's embedding and toughness) and the reinforcing material (providing the desired strength). The result of this combination is a high strength engineering material with acceptable toughness. At hybrid composites a third phase is also present therefore three basic types of hybrid systems can be envisioned. One is when the matrix is hybridised. For instance there is an intensive research on rubber filled thermoset resins (DOI: [10.1007/s10853-012-6564-2](https://doi.org/10.1007/s10853-012-6564-2)); but the combination of two resins could also be effective (DOI: [10.3311/PPme.7237](https://doi.org/10.3311/PPme.7237)). At this combination the purpose is usually to increase the mentioned moderate toughness. The second way of hybridization is when there are at least two kinds of reinforcing materials (e.g. DOI: [10.1177/0731684413516393](https://doi.org/10.1177/0731684413516393)) and the third one when both the matrix and the reinforcing material are hybridised (DOI: [10.1016/j.radphyschem.2011.11.015](https://doi.org/10.1016/j.radphyschem.2011.11.015)).

What are the main difficulties that obstruct the extensive use of this type of materials? One is that hybrid structures contain at least three phases, which makes the correlation between the structure and the mechanical properties much more complex compared to the

well-known two phase systems. Additionally in case of hybrid matrix, the formed morphology depends on several parameters and also the reinforcing material has to be considered. The cost of hybrid composite production due to their complexity is also higher compared to general purpose composites, as typically additional technological steps are necessary. As hybrid composites are relatively new group of materials their long term performance and cyclic behaviour have to be examined, too. It should also be mentioned that at the end of the life cycle the recycling of the hybrid parts can be carried out usually on low level (energy recovery) as the separation of constituent materials is not easy. Only one exception is available, when all of the components are from biodegradable materials. These materials will have great future in the field of biotechnology especially as human implants.

Significant part of the research has to address solving of the above mentioned problems in order to make these hybrid materials available for everyday use. In the near future detailed investigation is needed on their structural and mechanical behaviour and it is also relevant to manage their reproducible production and recycling.

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