Graphene based composites – are they for real in large-scale applications?

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Graphene as an additive to polymer composites has received a lot of attention both in academic and industrial research. Due to its potential for modifying mechanical, electrical, barrier, tribological, thermal or other properties of the surrounding matrix at the same time, graphene might be a candidate to achieve unique combinations of properties in composite materials.

Many technically valid studies published in this field have been done within the realm of a single material reporting great improvements in performance over the unmodified material. Looking at such results from an economic perspective as well, much more complex comparisons need to be made in many cases: For example, many polymer parts are not produced from the neat polymer but rather from polymers filled with a high amount of materials such as short glass fibres. In many cases, this existing solution leads to similar or even higher performance of the materials than the neat polymer with just graphene added can reach. In such cases, one has to compare the cost for the traditional additive with that of graphene to reach the same performance level. In addition to material costs also other aspects such as workability or abrasion properties of the polymer melt might need to be considered in order to draw an economically valid conclusion. Further possible competing solutions such as switching to another polymer instead of modifying one polymer by additives might need to be considered as well.

Many specific effects of graphene only will be relevant when graphene volume concentrations above a certain percolation threshold are added to the material. In certain cases, adding this amount of graphene to the full volume of the material might come at too high cost. In such cases, producing hierarchically structured materials in which graphene is contained only in a part of the volume in question might be an interesting approach to overcome this issue. In certain cases this may just mean the application of a functional coating, in other cases, more sophisticated approaches to create percolating graphene subvolumes might be needed.

Last but not least, the real benefits of graphene additives to a given material might become relevant only under conditions not readily tested with simple standard characterization methods but rather in application tests of entire model parts.

In the talk, examples for all three aspects will be presented.