The need for sustainable value chain bundles in scaling up innovations enabled by top-down GRM

Nikolaus Nestle

BASF SE Advanced Materials and Systems Research, RAA/OR B007, D-67056 Ludwigshafen, Germany

nikolaus.nestle@basf.com

Most of the present top-down manufacturing processes for graphene-related materials (GRM) involve an exfoliation step that produces materials with a wide range of different lateral dimensions and aspect ratios. Depending on the specifications for a GRM in a given application, a separation of the exfoliation product into different fractions is needed. In the scale-up of GRM production, this coupled production of different GRM becomes an increasingly relevant challenge both for economical and for environmental reasons. This is especially true for graphene applications in bulk materials such as composites or even concrete.

The best answer to this challenge is to come up with an ecosystem of different material innovations making use of different material fractions along with the scale-up of top-down GRM production. This requires transparent communication of GRM makers on the coupled nature of the production of different GRM and possible ranges of adaptations in the production. A further complication to this challenge comes from the fact that nominally geometrically similar types of GRM from different production processes might still be different from their chemical properties. On the way to higher TRL, standards have to be developed that cover such aspects as well.

On the side of the research and development community working on GRM-enhanced materials, an awareness of the at least partially coupled nature of GRM production and an appropriate bundling of projects requiring different types of GRM is needed for economically viable materials innovations. Such a project bundles will allow splitting the material and exfoliation cost between all resulting product fractions. From the point of view of sustainability, the production of waste materials is avoided if such a bundle of products can be developed jointly.

In cases where addition of GRM primarily replaces other additives, the price for the replaced quantity of state of the art additive also can be used as a benchmark for pricing the respective GRM fraction. Some examples will be shortly addressed. For easy market introduction of any GRM based additive solution, competitive prices with the benchmark additive solution and at least one additional benefit is preferable (such as easier processability, improvement in other properties compared to the state of the art solution or advantages in recycling or disposal of the product). With respect to property improvements (e.g. in mechanics) compared to state of the art additives, one has to be aware that the improvement in certain cases might actually be a less pronounced deterioration than for the present solution and like this a benefit that tends to be overlooked in any study focussed just on a single property.