Liquid graphene dispersions: formulation of a multipurpose additive

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Graphene, a monolayer of graphite, is a hexagonal lattice of carbon. It is a universal material that lends itself to a broad array of development, from energy storage and microelectronics to sensing or biomedicine. As graphene is presenting outstanding mechanical, electrical and thermal properties [1], a lot of scientific research is channelled on its production. Some techniques such as the adhesive-tape method or the chemical vapour deposition produce graphene of good quality but are not suitable for scaling-up to an industrial level. For this purpose, numerous research is focusing on the development of liquid formulations of graphene.

Thanks to an innovative process, Carbon Waters has achieved a major breakthrough in the field of advanced materials with the development of an industrializable process. We develop and provide ready-to-use graphene-based additives compatible with a wide range of materials and most common industrial processes, for a vast array of applications. We are fully involved in developing a more sustainable and safer industrial environment, with projects on nontoxic protective coatings, mechanical reinforcement, thermal resistance, and battery management. As a solution provider and a partner, we are continuously developing and testing new formulations based on customer's request. We support our clients throughout their entire project by understanding their expectations and proposing concrete solutions with fast implementation that are compatible with their process and cost objectives.

The CWEP (Carbon Waters Exfoliation Process) allows us to obtain liquid graphene dispersions of a very high quality, that are stable and "ready to use". The process – which generates a low carbon footprint and is recycling friendly - is based on the mechano-chemical exfoliation of graphite [2]. The first step is the preparation of a graphite intercalation compound (GIC), obtained through the reaction of alkali metals with graphite. In the second phase, the GIC is mixed with an organic solvent and exfoliated in solution to convert the graphite from several thousand layers to a few-layer graphene. A solution called "graphenide" is then obtained. The third step is the oxidation of the graphenide solution to produce organic graphene dispersions, which can be used directly for solvent-based applications (polymers-paints) or transferred into water to produce a very stable aqueous graphene dispersion, after solvent evaporation. Thanks to the continuous development of our process, the maximum concentration of graphene dispersions that we could reach so far is 1 $g.L^{-1}$.

The advantage of our process is the production of thin and high-quality graphene, leading to outstanding performance. Besides, the dispersions obtained do not contain any surfactant, commonly used to stabilize graphene. In order to strengthen its unique manufacturing process, Carbon Waters is currently filing two patents that focus on the adaptation of the process at the industrial scale.

References

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