Unravelling the boron nitride flakes morphology to enhance polycarbonate performances

E. Lago,[a,b] P.S. Toth,[a] S. Gentiluomo,[a,b] S.B. Thorat,[a] V. Pellegrini[a] and F. Bonaccorso[a]

[a]*Graphene Labs, Istituto Italiano di Tecnologia, Via Morego 30, 16163, Genoa, Italy*
[b]*Dipartimento di Chimica e Chimica Industriale, Università di Genova, Via Dodecaneso 31, 16146, Genoa, Italy*

emanuele.lago@iit.it

Abstract
The outstanding improvements of two-dimensional (2D) crystals-based composites in mechanical, electrical and thermal properties compared to pristine polymer matrices [1,2], have boosted the research activity in both 2D-crystals and polymer science fields. A key requirement for the application of 2D-crystals in the composites field relies on their large scale production [1]. In this view, liquid phase exfoliation (LPE) of layered-crystals [3,4] is one of the most promising approaches for the scalable production of high-quality 2D-crystals.
Herein, we design an environmentally friendly approach, based on the exfoliation of bulk *h*BN in a water/surfactant solution [5] with controlled lateral size (L) and thickness (t) by using ultra-centrifugation [6]. Our approach allow us to obtain two population of flakes, labelled as '*h*BN-s' and '*h*BN-p' with aspect ratio, i.e. L/t, equal to 400 and 300, respectively.
These flakes are subsequently used as filler in a polycarbonate (PC) matrix by means of solution blending technique, obtaining composite dispersions. The dispersions are then pelletized by pouring water, a solvent that does not dissolve the PC, which precipitates the composite materials. Finally, the pellets of the composite are hot-pressed to form ~100 µm thick films.
We tested the composite mechanical properties and we established a relationship between the polymer reinforcement and the filler morphology. *h*BN flakes with higher aspect ratio have shown better mechanical properties in terms of Young's Modulus (Figure 1), Tensile Strength at Yield and Ultimate Tensile Strength. Moreover, The obtained mechanical performances are better if compared with PC composites having graphene flakes of same aspect ratio [7]. As example, with only 0.5% of hBN-s flakes addition is possible to enhance by 27% the Young's Modulus of pristine PC, whereas the same increment is obtained by a two-fold and three-fold loading increase in the case of graphene and hBN-p flakes, respectively.

References

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Figures

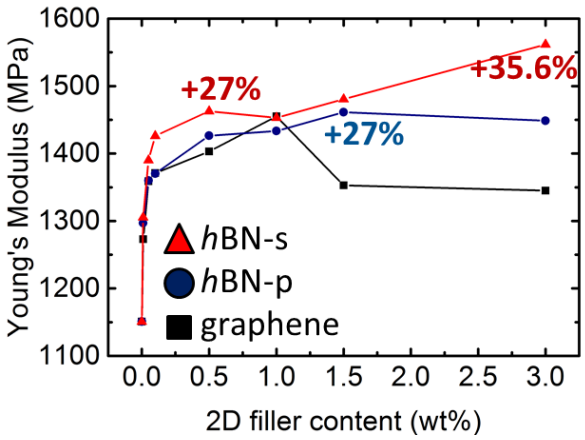

Figure 1: Mechanical properties, expressed in terms of Young's Modulus, of hBN-s/PC (red), hBN/PC (blue) and graphene/PC (black) composites.