Unravelling the boron nitride flakes morphology to enhance polycarbonate performances

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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 [1,2]. In this view, liquid phase exfoliation of layered-crystals is one of the most promising approaches for the scalable production of high-quality 2D-crystals [3,4]. However, the dependence of the 2D crystal flakes morphology, *i.e.*, lateral size and thickness, on the mechanical properties of the polymer composites is not fully undestood yet.

Herein, we tackle this issue by designing an environmentally friendly approach, based on the exfoliation of bulk hexagonal-Boron Nitride (*h*-BN) in a water/surfactant solution [5] with controlled lateral size and thickness by using cascade ultra-centrifugation (Figure 1a) [6]. Our approach allows us to obtain two populations of flakes, named *h*-BN-s and *h*-BN-p samples, with aspect ratio, *i.e.*, lateral size over thickness, equal to 250 and 350, respectively. The *h*-BN flakes with tuned aspect ratio are subsequently used as filler in a polycarbonate (PC) matrix by exploiting solution blending, obtaining composite dispersions. The composites produced by using the fillers with higher aspect ratio have shown the highest mechanical performances, both in terms of stiffness and strength. The first is evaluated measuring the Young's Modulus, *e.g.* +22 % compared to the pristine PC matrix obtained at 0.1 wt% of loading of *h*-BN-s flakes *vs.* + 17 % obtained at the same loading of *h*-BN-p flakes (Figure 1b). The strength is instead evaluated measuring ultimate tensile strength, *e.g.* +12 % compared to the pristine PC matrix obtained at 0.1 wt% of loading of *h*-BN-s flakes *vs.* + 6 % obtained at the same loading of *h*-BN-p flakes.

References

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Figures

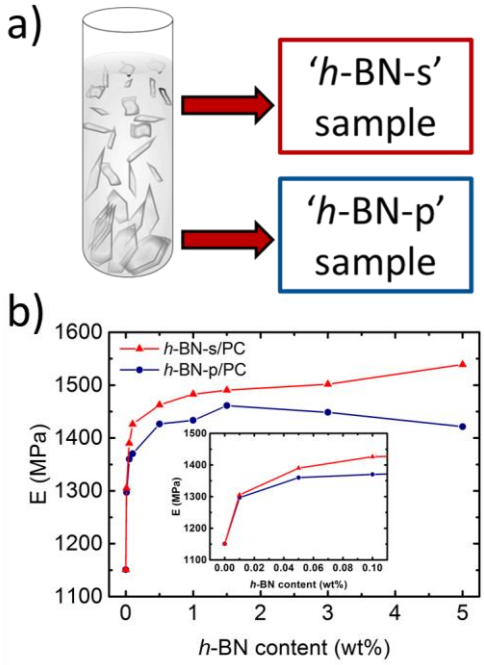

Figure 1: a) scheme of size selection of h-BN flakes by ultra-centrifugation; b) mechanical properties, expressed in terms of Young's Modulus, of hBN-s/PC (red), hBN/PC (blue) and graphene/PC (black) composites.