

## Industrial exfoliation of 2D graphene analogues for functional coatings

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This research focuses on the development of a top-down approach for the production of exfoliated hexagonal boron nitride (h-BN) as a 2D analogue of graphene. 2D materials have gained considerable attention in recent years due to their potential applications in various fields, such as semiconductors, biomedicine, and catalysis. In particular, h-BN presents the outstanding properties of graphene such as mechanical strength and thermal conductivity but is electrically insulating. However, the production of these materials has been mainly based on lab-scale methods, which are sometimes difficult to scale up for industrial production at moderate costs [1].

To overcome this challenge, the research proposes a top-down method for the production of exfoliated h-BN, which involves increasing the production from lab scale to semi-industrial scale using standard industrial methods such as ball milling [2][3]. A screening method was used to select the best surfactants, which could stabilize exfoliated h-BN flakes to a concentration above 1 mg/mL, the minimum concentration needed for standard deposition techniques.

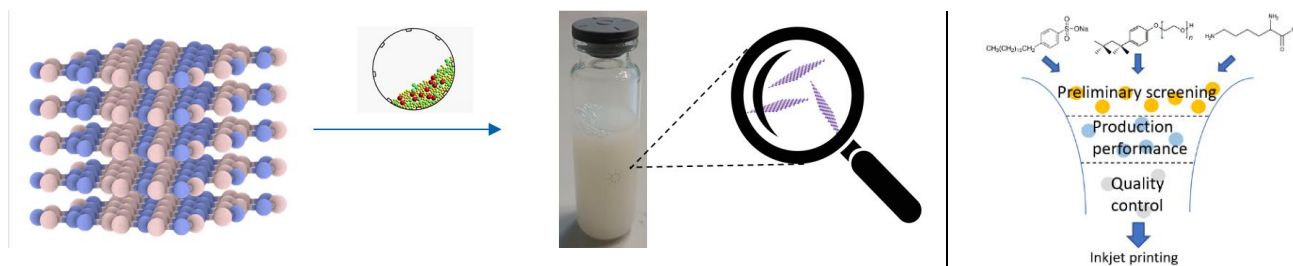
The solutions containing h-BN flakes and surfactants were then used to coat different surfaces such as aluminium and polyethylene terephthalate, to create thin layers of h-BN nanoflakes with the minimum presence of polymers, avoiding the use of composites or binders. These thin-layered h-BN systems are studied for their potential applications in thermal management systems and as protective coatings.

The results of this study demonstrate the feasibility of a top-down approach for the large-scale production of exfoliated h-BN. The surfactant selection process, combined with ball milling, proved to be an efficient method for producing stable dispersions of h-BN flakes. Thin layer h-BN coatings showed promising results for the potential of h-BN as a versatile 2D material for various applications.

### References

- [1] Bointon, T. H., Barnes, M. D., Russo, S., & Craciun, M. F., *Advanced Materials*, 27(28), 4200–4206 (2015).
- [2] Hu, C.-X., Shin, Y., Read, O., & Casiraghi, C., *Nanoscale*, 13(2), Article 2. (2021)
- [3] Ren, J., Stagi, L., & Innocenzi, P., *Journal of Materials Science*, 56(6), Article 6. (2021)  
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### Figures



**Figure 1:** Schemes of h-BN exfoliation from raw powder up to h-BN stabilized in solution (left) and screening method to select the best h-BN/surfactant combination (right).

