Halloysite nanotubes as promising candidates for the preparation of Polyamide-6 nanocomposites

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Halloysite is a polymorph of kaolinite which naturally wraps itself to form tubular structures. Due to its availability, low cost and morphology, it has gained attention in numerous fields of application, including functional coatings and polymer nanocomposites [1]. It is particularly suited to the filler role as it is cheap, thermally and mechanically resistant, and characterized by a high aspect ratio, crucial to guarantee strong polymer-filler interactions [2]. Clay powders are widely adopted as flame retardant additives at high percentages. The application of halloysite nanotubes (HNT) as additives at low contents for the tailoring of the mechanical and thermal properties of polymer composites has been instead much less investigated [3]. Our group investigated the use of HNT as additive at low content (< 5%w) in polyamide-6 (PA6) nanocomposites, due to its wide range of industrial application and relatively poor thermal and mechanical properties. Two different commercial HNT samples were adopted, showing different aspect ratios and purity (Fig. 1). The surface properties of both materials were modulated by functionalization with (3-aminopropyl)triethoxysilane (APTES). Samples were extensively characterized by TEM, BET, FTIR spectroscopy and ζ-potential measurements. Both extrusion and in-synthesis addition were tested, and the resulting nanocomposites were characterized by TGA, DSC, GPC, DMA and rheology measurements. Preliminary results suggest that the addition of HNT produces an increase in the crystallization temperature; the presence of HNT in the polymer matrix appears to favour the formation of the γ-phase of PA6. While APTES functionalization eased the filler incorporation during extrusion, it lowered the shear rate of the starting polymer. The obtained results suggested a large room for tunability of the properties of PA6/HNT nanocomposites.

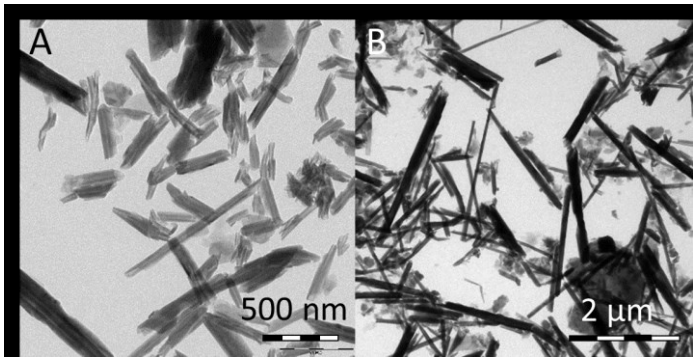

Figure 1. TEM images of the two HNT batches: those from Sigma-Aldrich (A) and those from iMinerals (B).

References

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