Title:

Unlocking Superior Properties in Polypropylene/Polyethylene Terephthalate (PP/PET) Blends using reactive compatibilization.

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Abstract:

Plastics play a critical role in modern society, with worldwide production expected to surpass 700 million metric tons by 2030 [1], [2]. Unfortunately, roughly 42% of these plastics are used for packaging purposes and are ultimately discarded, posing significant environmental concerns [3]. One promising approach involves the blending process of immiscible polymers, which constitute a significant portion of plastic waste, but they typically exhibit poor mechanical properties that hinder upcycling efforts [4]. Polypropylene (PP) and polyethylene terephthalate (PET) are widely used in various applications due to their excellent balance of mechanical and thermal properties. However, blending these polymers results in poor interfacial adhesion and poor properties, limiting their potential applications [5]. Therefore, improving the interfacial adhesion between PP and PET phases is crucial.

Reactive compatibilization is a promising approach to improve interfacial adhesion in PP/PET blends. In this study, we investigated the effect of adding a commercial compatibilizer, an Ethylene terpolymer-based compatibilizer (PTW), on the morphology, mechanical, rheology, and thermal properties of 70/30 PP/PET blends. We also explore the compatibilization mechanism to understand the improvements in the different properties.

Morphological analysis was able to identify a reduction in the particle domain size. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) were used to analyze the blend's morphology. The micrographs clearly showed a droplet-matrix morphology, where a continuous PP matrix surrounds the dispersed PET phase (i.e., 30%). The addition of PTW significantly reduced the PET droplets' average size from nearly 6 to 1 μm, indicating the effectiveness of PTW as a compatibilizer agent. However, an overload of PTW can lead to excess compatibilizer and agglomeration within the PET droplets, leading to a loss of size control.

Fourier-transform infrared spectroscopy (FTIR) analyses were conducted to further investigate the specific compatibilization mechanism. The results indicated that the PTW compatibilizer primarily acts at the interphase, improving the compatibility between the two phases and reducing the domain size.

The effect of PTW content on the blends' mechanical, thermal, and rheology properties was also investigated. The results showed that optimizing PTW content can significantly impact the blend's properties. At the optimal PTW content, the blend's tensile strength, elongation at break, and Young's modulus were improved compared to the uncompatibilized blend.

In summary, this study provides insight into the detailed characterization of PP/PET compatibilized blends and how this can be beneficial in further applications.
Note: maximum length of 400 words.