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Hidden Amorphous Phase Evolution in Stilbene–Polystyrene Composites Revealed by X-ray Diffraction

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X-ray diffraction studies of molecularly doped polymers are commonly focused on the appearance and growth of crystalline peaks, while changes in the amorphous polymer matrix are often treated as a static background. In this work, we show that the amorphous phase itself undergoes a systematic transformation in stilbene–polystyrene composites, which becomes evident only when analyzed beneath the dominant crystalline reflections.

Polystyrene films containing different concentrations of stilbene were investigated by X-ray diffraction under identical preparation conditions. As expected, increasing stilbene concentration leads to the emergence and strengthening of diffraction peaks associated with crystalline stilbene domains [1,2], from which characteristic crystallite sizes were estimated. However, in parallel, a broad amorphous halo attributed to polystyrene remains present in all spectra and changes markedly with dopant concentration.

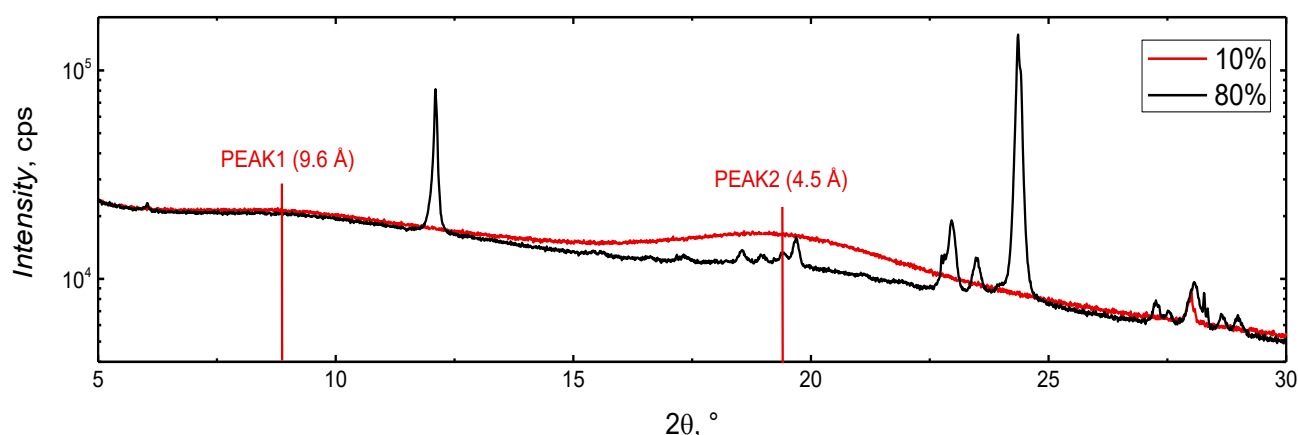


Fig. 1. XRD spectra of 10% and 80% of stilbene in polystyrene matrix highlighting amorphous peaks which corresponds to the distance of interchain ordering

These results highlight a hidden structural response of the amorphous phase, often masked by intense crystalline peaks in XRD patterns. The study emphasizes that molecular crystallization in polymer composites is accompanied by significant modifications of the surrounding amorphous environment, which should be considered when interpreting diffraction data and structure–property relationships in organic functional materials.

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