Exploring crystallinity of polymer blends on nanoscale

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Crystallinity is a key property of polymers that determines their mechanical, thermal, and optical characteristics. Understanding how crystallinity changes in polymer blends is essential in designing and developing polymer-based materials.

This work presents the use of PiFM (Photo-induced Force Microscopy, Figure 1) to study the crystallinity of polymer blends at the nanoscale. The technique involves using an infrared (IR) laser to induce molecular vibrations within the sample, which are then detected and analysed to provide information on the material's structure and composition.

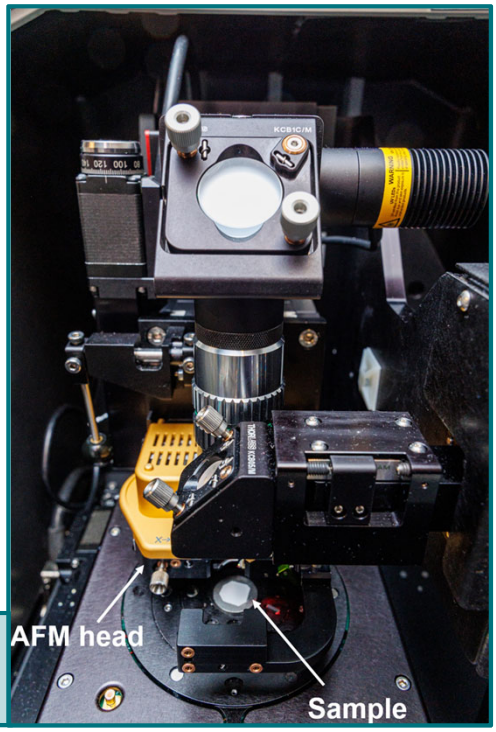
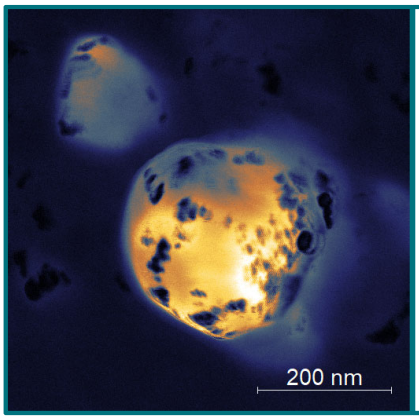


Fig.1

Photo-induced Force Microscope with a sample. PiFM combines Atomic Force Microscopy with Infrared spectroscopy (IR), which allows to take topography pictures and IR spectra with lateral resolution below 5 nm.

IR spectra of the matrix in the polymer blend (PE-PA6-EVOH) were measured in a close proximity to a PA6 domains (Figure 2), and changes in spectra – especially in peaks assigned to the crystalline part of the polymer – were observed in dependence on the distance from the minor phases. This provides insights into the crystallinity of polymer blends and how it can be controlled, which can help to improve their performance in various applications.



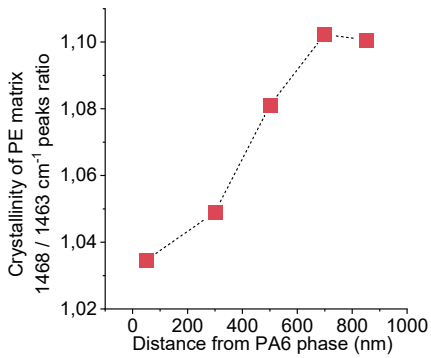


Fig. 2

Left: PiFM image of polymer blend consisting of PE-PA6-EVOH measured at 1650 cm^{-1}. The PA6 phase is represented with yellow color, and the PE matrix with dark blue color.
Right: The graph shows that the crystallinity of PE decreases with the distance from the PA6 phase. The crystallinity is expressed as a ratio of IR peaks for amorphous (1468 cm^{-1}) and crystalline (1463 cm^{-1}) PE.

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RESEARCH FOCUS: polymer recycling, Raman and IR spectroscopy analysis of polymers and composites

PROJECT: basic university research