

Cooperativity and structural relaxations in PVDF/PMMA blends in presence of MWNTs: an assessment through SAXS and dielectric spectroscopy

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Characterization

Fourier transform infrared (FTIR) spectroscopy was carried out using Perkin- Elmer GX in the range of 4000-400 cm^{-1} using a resolution of 4 cm^{-1} .

Wide angle X-ray diffraction (WAXRD) studies were analyzed using PANalytical Xpert pro to analyze the structure of PVDF/PMMA blends using a $\text{Cu K}\alpha$ radiation (1.54 Å, 40 k eV) and in the 2θ range of 5-50° with a scan rate of 0.04° s⁻¹.

Results and Discussion

MWNTs induced β phase in PVDF

We systematically investigated the crystal structure of the blends in presence of different MWNTs by FTIR and WAXD. Interestingly, the control blends and blends with COOH-MWNTs exhibited only the α crystal form whereas, the blends with NH_2 - and p-MWNTs revealed both the crystal forms (α and β). FTIR spectra is shown in Figure S1 and the magnified spectra in the region 400-1600 cm^{-1} is shown in S2. The characteristic peaks at 512, 600, 840 and 1279 cm^{-1} represent β -phase in the blends. The transmission peaks at 410, 530, 615, 764, 796, 851, 974, 1154, 1406 cm^{-1} represent α -phase of 80/20 PVDF/PMMA blends. We can clearly see that only in the blend with NH_2 -MWNTs and p-MWNTs, β -phase is present. Neat blend as well as blend with COOH-MWNTs show only α -phase of PVDF.

Further presence of β -phase in the blends is also supported by WAXD and is shown in Figure S3. Crystalline peaks at 2θ values of 17.8°, 18.48°, 20.1°, and 26.62° corresponds to α (100), α (020), α (110) and α (021) respectively. In the blend with NH_2 -MWNTs and p-MWNTs, one additional shoulder is obtained at $2\theta = 20.6^\circ$ and 20.7° corresponds to the β (200), β (110) respectively.

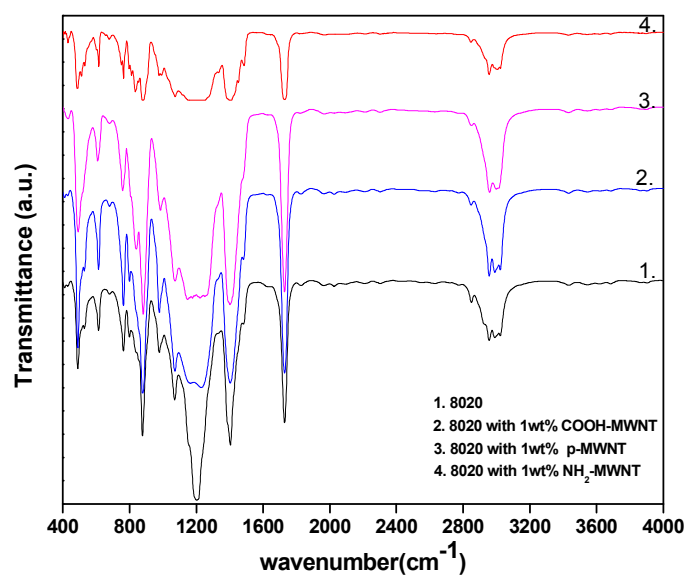


Figure S1: FTIR spectra for PVDF/PMMA blends and with different MWNTs

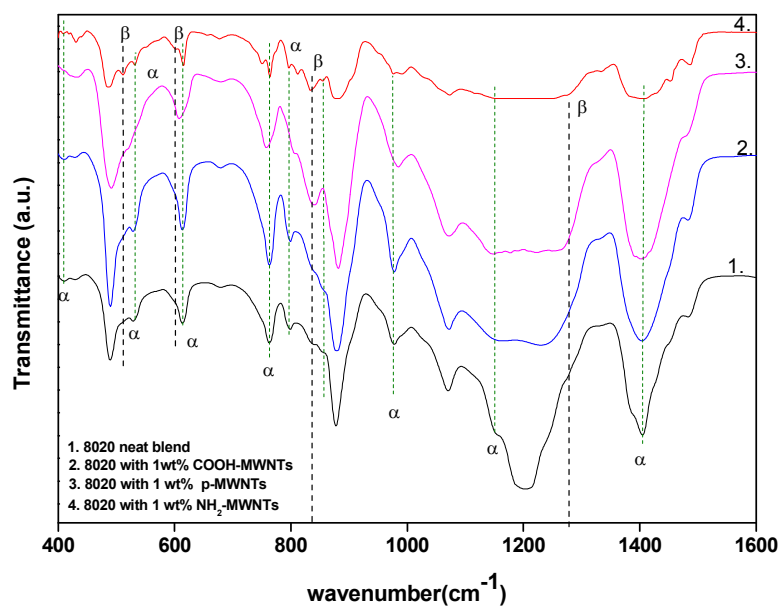


Figure S2: Magnified FTIR spectra in the region 400-1600 cm⁻¹

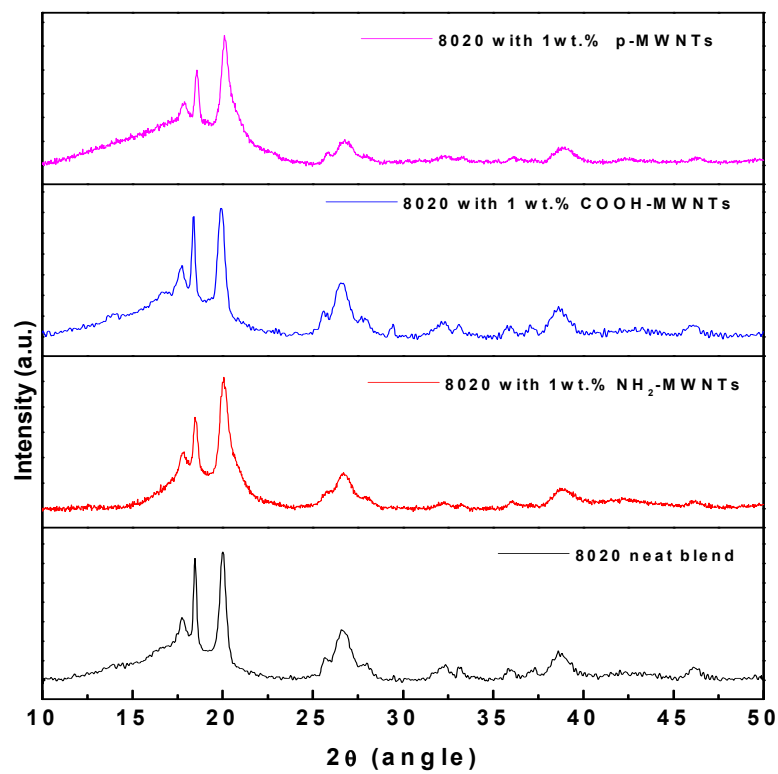


Figure S3: WAXD patterns for neat blends and blends with different functionalized MWNTs.