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A SMART APPROACH TO MODIFY PVDF POLYMORPHISM AND PROPERTIES

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Abstract

Nowadays, the investigation of processing methods effective in inducing the electroactive β polymorph of PVDF has become an important research topic in many energy related fields [1].
In this work, an alternative and smart approach to tune PVDF polymorphism was proposed, that is exploiting the compression moulding to induce, within the not completely molten material, internal shear stresses similar to those occurring in a rolling process [2]. The moulding conditions were properly modified to investigate their influence on the crystalline phases obtained. The electroactive phase amount was estimated by ATR-FTIR spectroscopy, after having carried out a principal component analysis in order to verify the representativeness of the two infrared bands usually used in literature for such a calculation [3]. A multiple linear regression was employed to evaluate the trend of the β phase quantity as a function of the plate thickness and moulding temperature, obtaining a non-monotonous trend, due to the effects of two contrasting factors: (i) the effectiveness of compression, which increases by increasing the amount of molten polymer; (ii) the phase transition, which involves only the solid portion of the polymer bulk. Taking into account this, a series of moulding conditions was selected to prepare PVDF samples for further morphological, calorimetric, structural, dynamic-mechanical and dielectric characterization. Gathered results indicate that the processing method, by changing the polymorphism of PVDF, consequently affects the dielectric response of the polymer but also changes its ultimate properties independently from the induced crystalline phases [4]. By hot pressing the PVDF below the melting temperature, an orienting effect (verified by polarized optical microscopy) was obtained, leading to the α to β phase transition and consequent increasing of the dielectric permittivity. On the other hand, the dielectric losses and the dynamic-mechanical properties appear to be not affected so much by the β phase content but rather by a different packing of the polymer chains.

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