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CRYSTAL TRANSFORMATION OF PVDF IN THE PRESENCE OF NANOCLAY AND MULTI-WALLED CARBON NANOTUBES

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Polyvinylidene fluoride (PVDF) a technologically important fluorinated polymer is a semi-crystalline polymer a well-known thermoplastic represents polymorphism which result in its piezo- pyroelectric properties upon charging under a strong electrical or corona field. These properties put this polymer in the heart of some important devices such as sensors. The most important crystalline form of PVDF is beta form (type I). This form of crystal is not thermodynamically stable in PVDF due to steric hindrance of fluorine atoms of CF2 groups in all-trans conformation of polymer chain. Consequently, alpha crystal (type II) directly formed from the melt. To obtain beta crystals different conventional techniques such as cold-drawing of PVDF parts to a strain of 400% at the moderate temperatures (say 87oC) should be employed. Development of nano-materials such as nanoclays and nanotubes has opened new horizons to this field of sensors and related devices. Both these nano-materials have been mixed with PVDF for different purposes and it was found that these nano-materials show a type of epitaxial effect on the crystalline form of PVDF. It is already found that Cloisite 30B and multi-walled nanotube (MWCNT) promotes formation of beta crystal from the melt. Based on our awareness no one has reported the synergistic effect of both these nano materials on the crystalline structure of PVDF. Here we report on the coexistence of Cloisite 30B and MWCNT and we found that at a rate of 3wt% modification a higher percentage of beta crystal was resulted as compared 3wt% of each nano-material. These changes in the crystalline structures were quantitatively and qualitatively by FT-IR and WXRD techniques, respectively. The morphology of the nano-materials and the state of dispersion were investigated using SEM and TEM techniques. The synergism we observed was assigned to difference in surface conformations and aspect ration of the nano-materials. These nano-composites insure formation of beta crystals without any need to apply 400% strain. Meanwhile, to attain piezo- pyroelectric properties there is a need to cold drawing but to a lesser strain which result lesser mechanical properties lost and anisotropy.