PREPARATION AND INVESTIGATION THE CRYSTALLINE STRUCTURE OF PVDF IN PVDF/PMMA/GRAPHENE NANOCOMPOSITES

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Polymer-based composites were heralded in the 1960s as a new paradigm for materials [1]. Graphene and graphite have recently attracted strong attention as versatile, environmentally friendly and available carbon materials which can be used as inexpensive filler in the composite materials [2,3]. Crystalline graphites are used in polymeric systems in order to improve polymer properties such as thermal and electrical conductivity, IR absorption, flame retardancy, barrier resistance, electromagnetic shielding, lubrication and abrasion resistance. When the crystalline graphite is exfoliated to individual graphene sheets, the specific surface would be as large as 2600 m^2g^{-1} and novel electronic and mechanical properties appeared [4].

Poly(vinylidene fluoride) (PVDF) is a semicrystalline engineering polymer with polymorphism structure. PVDF crystallizes in five different polymorphs, the so-called $\alpha, \beta, \gamma, \delta$ and ϵ forms. This polymer exhibites piezo and pyroelectric properties which have depended on the formation of the polar crystalline phase specially β phase [5].

Incorporation of graphene nanolayers in PVDF can results in the β phase due to donor: acceptor interactions between π orbital in nanographene and H atom with positive charge in PVDF [6]. But the low surface energy of fluorine atoms of PVDF results in aggregation of graphene layers. So the use of PMMA chains as compatiblizer can be useful since it is known to miscible with PVDF [7]. Beside it, graphene layers can disperse in PMMA matrix uniformly.

In this study, we prepared PMMA/graphene nanocomposite through in-situ polymerization as master batch and then mixed with PVDF by solution mixing and sonication. TEM, XRD, DSC, SEM and TGA were used to characterize the nanocomposites. From XRD results it can be concluded that PMMA can induces β-crystal in PVDF at low annealing temperature but graphene sheets can stabilize the β- and γ-phase at elevated temperature (90 and 120°C).

TEM analysis is a reliable technique to explore the dispersion of graphene sheets in polymer matrix. TEM images of PMMA-G master, 80/20 and 70/30 polymer blend of PVDV/PMMA nanocomposites are illustrated in fig.1.

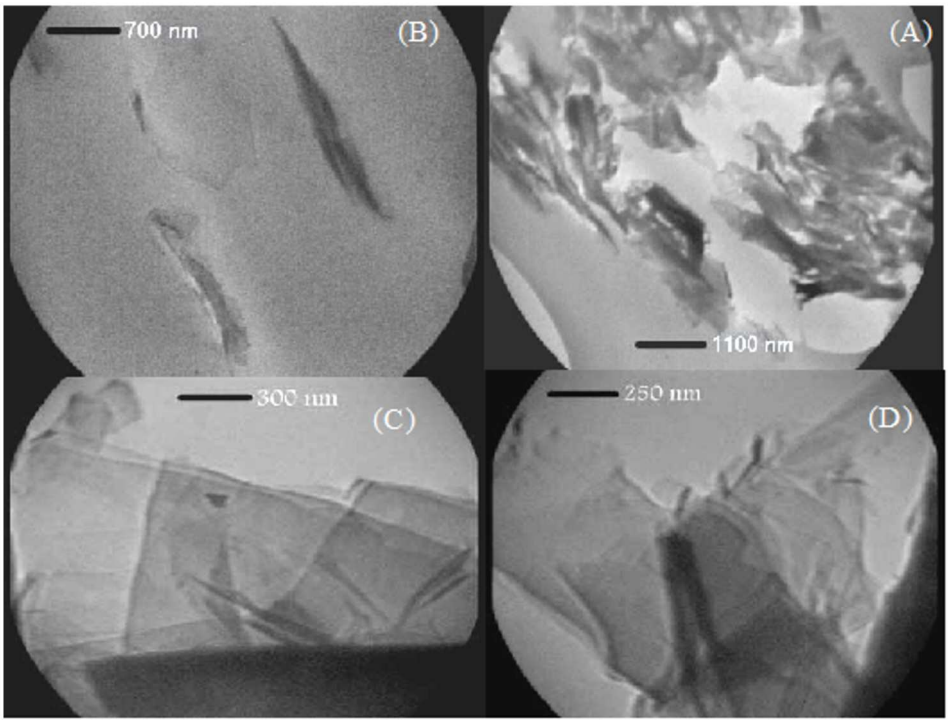

Figure 1: TEM images of PMMA-G master (A), 80/20 (B) and 70/30 polymer blend of PVDV/PMMA nanocomposites (C) and (D).

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