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Structures and Mechanical Properties of PVC/Na^+- Montmorillonite Nanocomposites

Chao Ying WAN, Xiu Ying QIAO, Yong ZHANG*, Yin Xi ZHANG

Research Institute of Polymer Materials, Shanghai Jiao Tong University, Shanghai 200240

Abstract: Poly (vinyl chloride)/Na^+-montmorillonite (PVC/MMT) nanocomposites with different MMT contents were prepared *via* melt blending. Wide-angle X-ray diffraction (WAXD) and transmission electron microscopy (TEM) were used to characterize the structures. Effects of MMT content on the mechanical properties were also studied. It is found that PVC molecular chains can intercalate into the gallery of MMT layers during melt blending process, the stiffness and toughness of the composites are improved simultaneously within 0.5~7wt% MMT content, and the transparency and mechanical properties decrease as MMT content further increases.

Keywords: Poly (vinyl chloride), montmorillonite, nanocomposite.

Polymer-layered silicate nanocomposites have drawn great attention in recent years. The nanoscale phase dispersion endows the composites with unique properties, such as high tensile strength and modulus, heat resistance, gas permeability barrier and flame-retardant properties, which are not realized in conventional filled composites at the same filler addition[1]. However, until now few publications have concerned with the investigation of poly (vinyl chloride)(PVC)/ layered silicate nanocomposites[2, 3], especially PVC/ Na^+- montmorillonite nanocomposites. In this paper, PVC/Na^+-MMT nanocomposites with different MMT content were prepared *via* melt blending, and their structrues and mechanical properties were investigated, which will be of significance for the broadening and deepening of the research fields of PVC nanocomposites.

Figure 1 is the X-ray diffraction patterns of PVC/Na^+-MMT nanocomposites with the different MMT content. As for the PVC/MMT composites, it is obvious that the (001) characteristic diffraction peak of MMT shifts to low angles and decreases in intensity. The increase of the interlayer distance of MMT can be attributed to the intercalation of the clay by PVC molecular chains, which can also be verified by TEM morphology observations. The layers of Na^+-MMT cannot be intercalated fully and some aggregation can be observed because of the high hydrophilic and ion-dipole interactions between the layers, as indicated in the experimental results of TEM.

The mechanical property parameters of PVC/ Na^+-MMT nanocomposites are listed in **Table 1**. Obviously, strength and toughness of the nanocomposites are enhanced

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*E-mail: yong_zhang@sjtu.edu.cn

simultaneously within 0.5~7wt% content of Na^+-MMT, compared to those of pristine PVC. It should be noted that when addition of Na^+-MMT is merely 0.5wt%, the tensile strength, notched Izod impact strength and flexural strength are enhanced by 21%, 28% and 23% respectively. The mechanical properties begin to decrease as the content of Na^+-MMT is above 7wt%. In addition, due to the partial intercalated structure, some clay aggregates of the order of micrometer exist in PVC matrix; therefore the light transmission of the composites decreases as Na^+-MMT content increases, which is characterized by Hazemeter. Therefore, a conclusion can be drawn that the proper content of Na^+-MMT is within 0.5~7wt% for enhancing mechanical properties and within 0.5~3wt% for keeping optical transparency for PVC/ Na^+-MMT nanocomposites.

Figure 1 X-ray diffraction patterns of Na^+-MMT and PVC/ Na^+-MMT nanocomposites

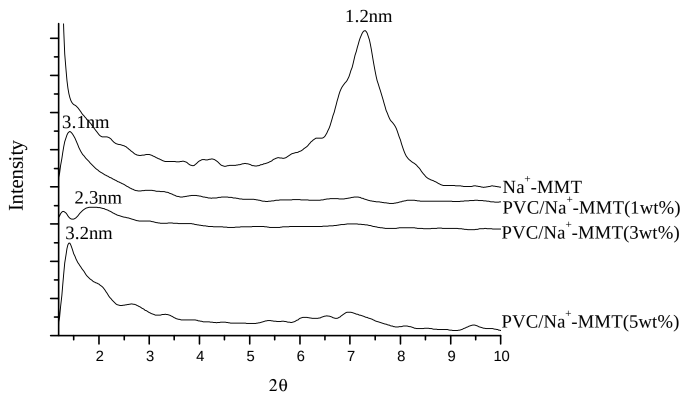

Table 1 Mechanical properties of PVC/Na^+-MMT nanocomposites

MMT content (wt%)	Tensile strength (MPa)	Notched Izod impact strength (J/m)	Flexural strength (MPa)	Flexural modulus (MPa)	Haze (%)
0	51.3	29	73.6	3380	26
0.5	62.1	37	90.5	3371	47
1	61.1	32	101.5	3300	65
3	60.5	38	101.5	3395	81
5	60.2	32	92.3	3497	—
7	60.3	32	92.9	3515	—
10	58.8	19	87.3	3620	—
15	56.4	19	80.0	3689	—

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