Preparation and Properties of Biodegradable Poly (Propylene Carbonate)/Montmorillonite Nanocomposites

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Abstract: Poly(propylene carbonate) (PPC)/organic montmorillonite (OMMT) composite were prepared by direct melt intercalation. XRD analysis indicated that PPC/OMMT nanocomposites with intercalated structure were prepared. Tensile strength and impact strength of the nanocomposites increased, while elongation at break decreased, compared with that of pure PPC. Moreover, T_g of the nanocomposites increased and the optimum mechanical and thermal properties occurred when OMMT content was 6%.

Key words: poly(propylene carbonate); organic montmorillonite; nanocomposites
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Poly(propylene carbonate) (PPC) is a degradable resin which is derived from carbon dioxide and propylene oxide. Its poor mechanical and thermal properties limit its application. Extensive researches on nanocomposites derived from clay and polymer matrix have been carried out improving its mechanical and thermal properties[1-4].

In this paper, PPC/organic montmorillonite (OMMT) composites were prepared by direct melt intercalation. Mechanical and thermal properties of composites were studied.

1 Experiments

1.1 Materials

Poly(propylene carbonate) (PPC) was provided by Inner Mongolia Mengxi Co., Ltd. Organic montmorillonite (OMMT) was provided by Zhejiang Fenghong clay chemicals Co., Ltd.

1.2 Preparation of nanocomposites

PPC and varipus amounts of OMMT were mixed in a container and then melt blended using a Hake rheometer at screw speed of 40 r/min and 110 ℃ for 5 min.

1.3 Measurements

XRD spectra were obtained using a XRD meter (D8-advance, Bruker) with Cu K_α radiation (λ = 0.154 nm) and a scanning rate of 10 °/min, diffraction angle from 1.7° to 10°.

Tensile strength tests were performed according to ASTM D638 on mechanical properties tester (CMT4204). Unnotched charpy impact strength tests were performed on mechanical properties tester (ZBC-500B), according to ASTM D256 standard at room temperature.

Dynamic mechanical properties of samples were measured with a DuPont (model 983, America) dynamic mechanical analyzer. The analyzer was operated at a fixed frequency of 1 Hz and oscillation amplitude of 0.2 mm, at a heating rate of 5 ℃/min under nitrogen atmosphere.

2 Result and discussion

2.1 XRD of OMMT and PPC/OMMT

As shown in Fig.1, Characteristic diffraction peak d001 of OMMT located at 4.12° with a basal spacing of 2.54 nm according to Braggs equation. Characteristic diffraction peak d001 of PPC/OMMT composite shifted to 2.73° with a basal spacing of 3.29 nm, which indicated that PPC molecular chains had intercalated into OMMT interlayer and enlarged interlayer spacing.

2.2 Mechanical properties of PPC/OMMT

Tensile strength of the nanocomposites increased with OMMT content up to 6 wt%. Tensile strength of the nanocomposite with 6 wt% OMMT increased 424.5% compared with that of pure PPC. When OMMT content exceeded 6 wt%, part OMMT might agglomerate, which deteriorated tensile properties. With OMMT content increased, elongation at break decreased. Elongation at break of nanocomposite with 6 wt% OMMT was 89.2%. Impact strength showed a similar tendency to tensile strength with OMMT content

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increased. Impact strength of the nanocomposite with 6% OMMT increased by 84.6%.

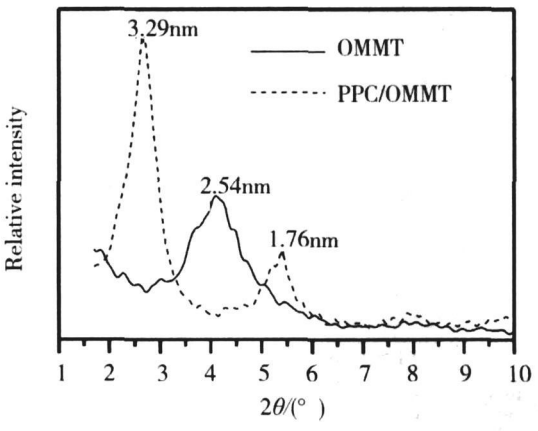

Fig.1　XRD of OMMT and PPC/OMMT

2.3　Thermal properties of PPC/OMMT

With OMMT content increased from 0 wt% to 8 wt%, Tg of nanocomposies was 51.3 ℃, 53.6 ℃, 54.3 ℃, 56.6 ℃, 56.4 ℃ respectively. Increase in Tg was attributed to barrier effect of OMMT layer. While clay content exceeded 6 wt%, decrease in Tg might be attributed to aggregation of OMMT.

3　Conclusions

Poly(propylene carbonate) (PPC)/organic montmorillonite(OMMT) composites were prepared by direct melt intercalation. Tensile strength and impact strength of nanocomposites increased, while elongation at break decreased, compared with that of pure PPC. DMA result showed that Tg of nanocomposites increased. The optimum mechanical and thermal properties occurred when OMMT content was 6 wt%.

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聚碳酸亚丙酯/有机蒙脱土纳米复合材料的制备与性能

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摘　要：通过熔融插层法制备了聚碳酸亚丙酯（PPC）/有机蒙脱土（OMMT）复合材料。XRD分析表明：PPC/OMMT复合材料形成了插层型纳米复合结构。相对于纯PPC材料，纳米复合材料的拉伸性能和抗冲击性能得到了显著提高，但复合材料的断裂伸长率降低。当OMMT含量为6%时，PPC/OMMT纳米复合材料具有最优的力学性能和最高的玻璃化温度。

关键词：聚碳酸亚丙酯；有机蒙脱土；米复合材料
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