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ENHANCED FLAME RETARDANT PROPERTIES OF WOOD-BASED COMPOSITE BOARD BY ADDITION OF GRAPHENE NANOPLATELET

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Introduction

In general, wood is widely applied to interior and exterior materials for buildings due to its eco-friendly and excellent physical · chemical properties. However, wood is flammable, prone to burning when exposed to heat, diffuses the flame at high speed and releases cracking gas. In order to improve for flammability of wood, some methods are used such as mixing with flame retardant filler and coating on the surface of wood[1]. Recently, many studies have been conducted using carbon materials as flame retardant additive[2]. Carbon materials, which have high thermal stability, can decrease the maximum heat release and facilitate the formation of char layer during combustion. In this study, Graphene nanoplatelet (GnP)/phenolic foam (PF)/Wood composite boards were fabricated with different GnP content as 5, 10 and 20 wt% to investigate the effect of GnP on thermal- and flame retardant properties of wood-based composite board.

Materials and Methods

Waste wood (sawdust) and distilled wood glue were mixed and dried in oven at 100 ℃ for 2 h. Then glued wood, PF and GnP were mixed. In this step, the ratio of wood and PF was 7 : 3 wt% and GnP contents were 0, 5, 10, 20 wt%. Composite boards were fabricated by hot pressing of the mixture. Hot pressing was conducted at 150 ℃, 200 bar for 15 min. Prepared samples were named as Wood, PF/W, 5-GnP/PF/W, 10-GnP/PF/W, 10-GnP/PF/W according to the GnP contents. The morphology of the fracture plane of composite boards was observed by scanning electron microscopy (SEM). Thermal- and flame retardant properties of fabricated composite boards were investigated by thermogravimetric analysis (TGA) and Limiting oxygen index (LOI), respectively.

Results and Discussion

The SEM was conducted to observe morphology and dispersibility of prepared composite boards. PF particles were mixed between fibrous wood, and GnP was uniformly dispersed on the surface of wood and PF. In TGA result conducted under air and N_2 atmosphere, the thermal stability of the composite boards increased proportionally with the amount of GnP, and the char yield of these boards was about 22 % higher than that of the pure wood board as shown in Table 1 and Figure 1. Moreover, initial thermal degradation temperature was effectively delayed according to addition of PF and GnP. LOI value of composite boards, which means minimum oxygen concentration required for combustion, also increased about 4.8~7.8% compared that of the pure wood board. Therefore, it was confirmed that thermal and flame retardant properties of composite boards were

remarkably improved by addition of re-PF and GnP. Especially, GnP as carbon–based material, facilitated formation of char layer and increased effectively char yield, so it showed higher effect on flame retardant properties than to the PF.

Table 1. Charred Residues and Carbonization Yield of GnP/re-PF/W Composite Boards

	Wood	PF/W	5-GnP/PF/W	10-GnP/PF/W	20-GnP/PF/W
Char yield (%) (at 500 ℃ in Air)	0.6	4.3	8.3	17.5	22.6
Carbonization yield (%) (at 900℃ in N_2)	22.8	26.7	26.8	28.3	34.4

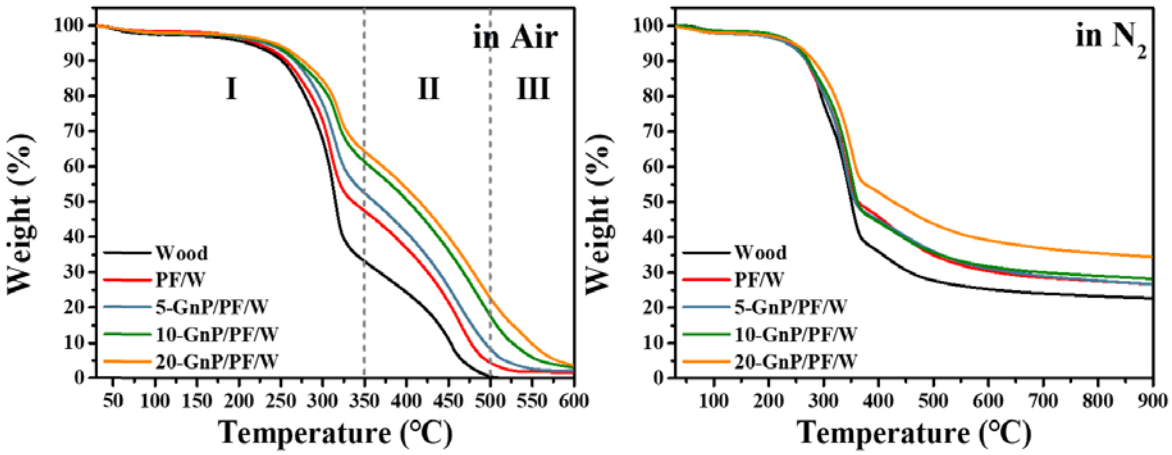

Figure 1. TGA curves of GnP/re-PF/W composite boards analyzed under air and N_2 atmosphere.

Conclusions

Graphene nanoplatelet (GnP)/phenolic foam (PF)/Wood composite boards were fabricated and investigated the effect of GnP on improvement thermal and flame retardant properties of wood-based composite board. The thermal stability and char yield of composite boards increased proportionally with the amount of GnP. Flame retardant properties of composite boards investigated by LOI test were also remarkably improved compared to the pure wood board. These results are because PF and GnP with high thermal stability delayed the initial thermal degradation temperature of composite boards and made their char layers denser and thicker, so they led combustion delay effect of composite board.

Acknowledgment

References

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