Barrier Films based on EVOH and Graphene Oxide

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1. Introduction

Graphene, the 2D lattice of sp\textsuperscript{2}-bonded carbon atoms from which graphite, carbon nanotubes, and fullerenes are derived, has emerged in recent years as a novel and important class of materials on its own merit. Graphene has exceptional physical, chemical, electrical and mechanical properties.[1-4] Another benefit from graphene is gas impermeable atomic membrane.[5]

Ethylene vinyl alcohol (EVOH) shows good thermal stability, high chemical resistance and gas been used as a food packaging material due to its excellent gas barrier properties and harmlessness toward health.[6]

In this work, we investigated the properties of GO/EVOH nanocomposites.

2. Experimental Section

2.1. Preparation of EVOH/GO composite film

GO was prepared from purified conventional flake graphite by modified Hummers method.

EVOH/GO nanocomposites were synthesized by solvent mixing method of EVOH in a colloidal solution of GO. EVOH/GO nanocomposites (0.1wt\%) were as follows: EVOH(3g) was dissolved in distilled water and isopropyl alcohol (IPA) (weight ratio water/IPA = 1). A colloidal solution(6mL) of GO(3mg) was added to the EVOH solution and stirring for 24hr. Each EVOH/GO hybrid solution was cast onto PET film and then dried for 1hr. The films were dried again in a vacuum oven for 4hr. A series of EVOH/GO nanocomposites films with different GO loadings were similarly prepared.

2.2. Characterization

Light transmittance of nanocomposites was measured with UV-vis at 550nm. Gas barrier of nanocomposites was measured with Illinois Instrument Model 8001. The differential scanning calorimetry(DSC) pattern of samples were measured with DSC at a heating rate of 10\textdegree C/min. XRD experiments were performed directly on the hybrid samples with Cu irradiation at the scanning rate of 0.02/s in the 2 range of 2~40.

3. Result and Discussion

XRD indicated that GO was nearly exfoliated. (Fig.1.). Light transmittance at 550nm is 95.8\% for the EVOH/GO composite film containing 0.1wt\% GO and 84.8\% for the film containing 0.3wt\% (Fig.3.). The oxygen transmission rate (O\textsubscript{2}TR) and water vapor transmission (WVTR) of EVOH/GO (0.3wt\%) composite reduces to 67\% and 98\% of that EVOH coated PET film. (Fig.4.).

4. Conclusion
GO is exfoliated in EVOH/GO composite. The O$_2$TR and WVTR of EVOH/GO (0.3wt.\%) composite coated PET film is lower than that of pure PET film. The barrier property of EVOH film is improved when it is contained GO. EVOH/GO films are promising for the development of transparent high gas barrier film.

![Fig.1. The XRD pattern of EVOH/GO nanocomposites.](image)

![Fig.2. DSC pattern of EVOH/GO composites.](image)

![Fig.3. Light transmittance of EVOH/GO film at 550nm.](image)

**Table 1. The oxygen permeability and water permeability of EVOH/GO film.**

<table>
<thead>
<tr>
<th>GO [wt.%]</th>
<th>$P_{Oxygen}/P_{PET}$</th>
<th>$P_{Water}/P_{PET}$</th>
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<tbody>
<tr>
<td>0</td>
<td>0.0198</td>
<td>7.0220e-4</td>
</tr>
<tr>
<td>0.15</td>
<td>0.0128</td>
<td>7.0391e-4</td>
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<td>0.3</td>
<td>0.0124</td>
<td>6.9172e-4</td>
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5. References


