MECHANICAL AND BARRIER PROPERTIES OF POLYLACTIC ACID/ SURFACTANT-STABILIZED GRAPHENE NANOCOMPOSITE FILM

INTISARI

Oleh:

CAHYO HANDOKO
14/363952/TP/10930

Penambahan *graphene* sebagai *nano-filler* merupakan upaya untuk meningkatkan sifat mekanis dan *water vapor permeability* (WVP) dari Polylactic acid (PLA) sebagai *biodegradable film*. PLA dengan nanokomposit disiapkan melalui metode *solution blending*, menggunakan Tetrahydrofuran (THF) sebagai pelarut organik. Dalam upaya meningkatkan penyebaran *graphene nano-platelets* pada pelarut THF dan PLA, surfaktan *quaternary ammonium*, khususnya Didodecyldimethylammonium bromide (DDAB) dan Benzyl dimethyl dodecylammonium chloride (BDAC) yang digunakan untuk memodifikasi *graphene* dalam penelitian ini.

Pengaruh rasio yang berbeda dari surfaktan dan *graphene* pada sifat mekanis dan WVP pada PLA/ *surfactant-stabilized graphene* nanokomposit film diteliti dan dilakukan perbandingan dengan film dari PLA/ *graphene* dan PLA control. Disimpulkan bahwa *surfactant-stabilized graphene* pada jumlah rasio surfaktan yang kecil dapat meningkatkan sifat mekanis (*tensile strength* dan *elongation at break*) dan menurunkan WVP, sedangkan pada rasio yang lebih tinggi, *surfactant-stabilized graphene* hanya menurun WVP dibandingkan dengan film PLA control.

Penambahan Graphene dan BDAC-*stabilized graphene* meningkatkan nilai terbaik pada *tensile strength* 58% dan 21% serta *elongation at break* sekitar 38% dan 46%, pada masing-masing sampel, serta penurunan WVP sebesar 65% dan 52%, pada masing-masing sampel, dibandingkan dengan film PLA control. DDAB- *stabilized graphene* menurunkan kekuatan tarik sebesar 14%, *elongation at break* sebesar 23%, dan WVP 19% dibandingkan dengan film PLA control. Sebaliknya, rasio yang tinggi antara surfaktan/graphene dan *stabilized graphene* meningkatkan *elongation at break* pada PLA/ DDAB-*stabilized graphene* sebesar 12% dan menurunkan *tensile strength* sebesar 18-47%. Nilai WVP menurun sebesar 33-47% untuk kedua sampel film PLA/ BDAC- dan PLA/ DDAB-*stabilized graphene*, dibandingkan dengan film PLA control.

Kata kunci: *Polylactic acid, Graphene, Surfactant, Nanocomposite Film, Mechanical Properties, Water Vapor Permeability*

MECHANICAL AND BARRIER PROPERTIES OF POLYLACTIC ACID/ SURFACTANT-STABILIZED GRAPHENE NANOCOMPOSITE FILM

ABSTRACT

By:

CAHYO HANDOKO
14/363952/TP/10930

Adding graphene as a nano-filler is an effort to improve the mechanical and water vapor barrier (WVP) properties of biodegradable Polylactic acid (PLA) films. The PLA nanocomposite films were prepared via solution blending method, using Tetrahydrofuran (THF) as an organic solvent. In order to improve the dispersion of graphene nano-platelets in THF and in PLA solution, the quaternary ammonium surfactants, specifically Didodecyldimethylammonium bromide (DDAB) and Benzyl dimethyl dodecylammonium chloride (BDAC) were used to modified graphene in this study.

The effect of different ratios of surfactant and graphene on the mechanical properties and the WVP of PLA/surfactant-stabilized graphene nanocomposites film was investigated compared with those of PLA/ Graphene and PLA neat film. It was found that the surfactant-stabilized graphene at small amount of surfactant could improve both mechanical properties (tensile strength and elongation at break) and decreased WVP, while at high ratio, surfactant-stabilized graphene decreased only WVP compared with PLA neat film.

Graphene and BDAC-stabilized graphene showed the best improvement that it increased the tensile strength 58% and 21% also elongation at break at about 38% and 46%, respectively, as well as decreased WVP at 65% and 52%, respectively, compared with PLA neat film. DDAB-stabilized graphene decreased the tensile strength at 14%, elongation at break at 23%, and the WVP 19% compared with PLA neat film. In contrast, high ratio of surfactant/graphene, surfactant-stabilized graphene increased elongation at break PLA/ DDAB-stabilized graphene films at 12% and decreased tensile strength at 18-47%. The water vapor barrier property at 33-47% for both PLA/ BDAC- and PLA/ DDAB-stabilized graphene films, compared with PLA neat film.

Keywords: *Polylactic acid, Graphene, Surfactant, Nanocomposite Film, Mechanical Properties, Water Vapor Permeability*