MULTILAYER BARRIER STACK

TECHNICAL FIELD

The present disclosure relates to multilayer barrier stacks or films including a smooth layer and a barrier layer.

BACKGROUND

A wide range of products from food package, medical package, electronic package, solar cell to display require protection from oxygen and/or water ingress and protection from scratching. Barrier coatings or films have been developed to protect such products. Available barrier coatings or films generally are a stack of continuous layers including a substrate and a barrier film overlaying the substrate, where the substrate and barrier film as a whole can provide protection for the products.

SUMMARY

Briefly, in one aspect, the present disclosure describes a multilayer barrier film including a polymeric layer comprising a thiol-ene material as a polymeric matrix material and particles hosted by the polymeric matrix material, and a barrier layer directly disposed on the polymeric layer. In some cases, the thiol-ene material includes a cured thiol-ene resin having a glass transition temperature (Tg) > 20°C.

In another aspect, the present disclosure describes a multilayer barrier film including a substrate having a first major surface and a second major surface opposite the first major surface, and a first polymeric layer directly disposed on the first major surface of the substrate. A second polymeric layer is directly disposed on the second major surface of the substrate. The first and second polymeric layers each comprise a thiol-ene material as a polymeric matrix material and particles hosted by the polymeric matrix material. A first barrier layer is directly disposed on the first polymeric layer, and a second barrier layer is directly disposed on the second polymeric layer.

Various unexpected results and advantages are obtained in exemplary embodiments of the disclosure. One such advantage of exemplary embodiments of the present disclosure is that some multilayer barrier films include a smooth layer containing a thiol-ene material as a polymeric matrix material for hosting nanoparticles, and some multilayer barrier films have a sandwich structure, either of which or combination thereof can provide excellent barrier performance.

What is claimed is:

1. A multilayer barrier film, comprising:

a polymeric layer comprising a thiol-ene material as a polymeric matrix material and particles hosted by the polymeric matrix material; and

a barrier layer directly disposed on the polymeric layer.

2. The multilayer barrier film of claim 1, wherein the barrier layer is formed by a sputtering or ALD process, and the barrier layer comprises silicon oxide, aluminum oxide, titanium oxide, or a combination thereof.

3. The multilayer barrier film of claim 1, wherein the barrier layer comprises indium tin oxide (ITO).

4. The multilayer barrier film of claim 1, wherein the polymeric layer has a thickness no less than about one micron.

5. The multilayer barrier film of claim 1, wherein the barrier layer comprises a random covalent network containing one or more of carbon and silicon, and one or more of oxygen, nitrogen, hydrogen and fluorine.

6. The multilayer barrier film of claim 1, wherein the barrier layer is a layer of diamond-like glass (DLG) material.

7. The multilayer barrier film of claim 1, wherein the thiol-ene material is formed by curing one or more polythiol monomers with one or more polyene monomers.

8. The multilayer barrier film of claim 1, wherein the polymeric layer further comprises one or more acrylate enes.

9. A multilayer barrier film comprising:

a substrate having a first major surface, and a second major surface opposite the first major surface;

a first polymeric layer directly disposed on the first major surface of the substrate, a second polymeric layer directly disposed on the second major surface of the substrate, the first and second polymeric layers each comprising a thiol-ene material as a polymeric matrix material and particles hosted by the polymeric matrix material; and

a first barrier layer directly disposed on the first polymeric layer, and a second barrier layer directly disposed on the second polymeric layer.

10. The multilayer barrier film of claim 9, wherein the barrier layer is formed by a sputtering or ALD process, and the barrier layer comprises silicon oxide, aluminum oxide, titanium oxide, or a combination thereof.

11. The multilayer barrier film of claim 9, wherein the barrier layer comprises indium tin oxide (ITO).

12 The multilayer barrier film of claim 9, wherein the polymeric matrix material in at least one of the first and second polymeric layers comprises one or more cured thiol-ene materials.

13. The multilayer barrier film of claim 9, wherein at least one of the first and second barrier layers comprises a random covalent network containing one or more of carbon and silicon, and one or more of oxygen, nitrogen, hydrogen and fluorine.

14. The multilayer barrier film of claim 9, wherein at least one of the first and second barrier layers is a layer of diamond-like glass (DLG) material.