MULTILAYER BARRIER COATINGS

TECHNICAL FIELD

The present disclosure relates to multilayer barrier coatings including a hardcoat layer and a barrier layer.

BACKGROUND

Many articles such as organic light emitting diodes (OLEDs), organic and inorganic photovoltaics (PV), quantum dot display (QDD) devices require protection from oxygen and/or water ingress. Barrier coatings or films have been developed to protect articles or devices in various industrial fields such as food package, medical storage, electronic industry, etc. Available barrier coatings or films use metals or glasses to protect the devices.

SUMMARY

There is a need to improve properties (e.g., flexibility, optical properties, anti-scratching, anti-cracking, moisture barrier performance, etc.) of barrier coatings or films. Briefly, the present disclosure describes a multilayer barrier film including a hardcoat layer comprising nanoparticles hosted by a binder. The binder includes one or more silicone (meth)acrylate additives. A barrier layer is directly disposed on a major surface of the hardcoat layer. In one aspect, the present disclosure describes a multilayer barrier film, comprising: a hardcoat layer comprising nanoparticles hosted by a binder, the binder comprising one or more silicone (meth)acrylate additives; and a barrier layer directly disposed on a major surface of the hardcoat layer.

The present disclosure describes a device that includes a multilayer barrier film described herein. The device further includes a cover panel and an optically clear adhesive layer. The multilayer barrier film is disposed between the cover panel and the optically clear adhesive layer, and configured to prevent diffusion of moisture or oxygen from the cover panel to the optically clear adhesive layer. In another aspect, the present disclosure describes a device comprising the multilayer barrier film as defined herein, the device further comprising a cover panel and an optically clear adhesive layer, the multilayer barrier film is disposed between the cover panel and the optically clear adhesive layer, and configured to prevent diffusion of moisture or oxygen from the cover panel to the optically clear adhesive layer. In some embodiments, the device is a liquid crystal display (LCD).

The present disclosure describes a method of making a multilayer barrier film. The method includes providing a mixture comprising nanoparticles and one or more curable binder materials, and curing the binder materials to provide a hardcoat layer. The hardcoat layer includes the nanoparticles hosted by a binder. The binder includes one or more silicone (meth)acrylate additives. A barrier layer is provided directly disposed on the hardcoat layer. In another aspect, the present disclosure describes a method of making a multilayer barrier film, the method comprising: providing a mixture comprising nanoparticles and one or more curable binder materials; curing the binder materials to provide a hardcoat layer, the hardcoat layer comprising the nanoparticles hosted by the binder, the binder further comprising one or more silicone (meth)acrylate additives; and providing a barrier layer directly disposed on the hardcoat 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 by

What is claimed is:

1. A multilayer barrier film, comprising:

a hardcoat layer comprising nanoparticles hosted by a binder, the binder comprising one or more silicone (meth)acrylate additives; and

a barrier layer directly disposed on a major surface of the hardcoat layer.

2. The multilayer barrier film of claim 1, wherein the one or more silicone (meth)acrylate additives include polydimethylsiloxane (PDMS) acrylate, and the hardcoat layer comprises from about 0.01 wt% to about 10 wt% of the polydimethylsiloxane (PDMS) acrylate based on the total weight of the hardcoat layer.

3. The multilayer barrier film of claim 1, wherein the binder of the hardcoat layer further comprises cured acrylate formed by curing at least one of acrylic, (meth)acrylic oligomer, or monomer binder.

4. The multilayer barrier film of claim 1, wherein the hardcoat layer comprises from about 15 wt% to about 70 wt% of the binder and from about 30 wt% to about 85 wt% of the nanoparticles based on the total weight of the hardcoat layer.

5. The multilayer barrier film of claim 1, wherein the nanoparticles comprise from about 10 wt% to 50 wt% of a first group of nanoparticles having an average particle diameter in a range from 2 nm to 200 nm, and from about 50 wt% to about 90 wt% of a second group of nanoparticles having an average particle diameter in a range from 60 nm to 400 nm.

6. The multilayer barrier film of claim 5, wherein the ratio of average particle diameters of the first group of nanoparticles and the second group of nanoparticles is in a range from 1:2 to 1:200.

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

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