# MULTILAYER REFLECTIVE POLARIZER WITH EMBEDDED ABSORBING ELEMENTS

## Background

Multilayer optical films, which include co-extruded and stretched alternating thermoplastic birefringent layers, are useful as reflective polarizers and mirrors. Conventional backlight stacks, including those found in liquid crystal displays, may include one or more absorbing polarizers—which generally may be polymeric (such as polyvinyl alcohol) bodies including absorbing polarizing dyes—as an antireflection layer.

## Summary

The present disclosure relates to a hybrid polarizer. More particularly, the present disclosure relates to hybrid polarizers having a reflective polarizer portion and a hybrid portion. The reflective polarizer portion includes alternating high index layers and low index layers, where the reflective polarizer portion is substantially free of absorbing polarizer elements. The hybrid polarizer portion is disposed on the reflective polarizer portion and includes alternating high index layers and low index layers, where at least some of the high index layers of the hybrid polarizer portion include absorbing polarizer elements.

In one aspect, the present disclosure relates to a hybrid polarizer, comprising: a reflective polarizer portion, including alternating high index layers and low index layers, wherein the reflective polarizer portion is substantially free of absorbing polarizer elements; and a hybrid polarizer portion disposed on the reflective polarizer portion, including alternating high index layers and low index layers, wherein each of the high index layers of the hybrid polarizer portion include absorbing polarizer elements.

In some embodiments, each of the high index layers of the hybrid polarizer portion includes absorbing polarizer elements. In some embodiments, the absorbing polarizing elements are dyes. The dyes may be polarizing dyes. In some embodiments, the hybrid polarizer further includes an absorbing polarizer disposed on the hybrid polarizer portion. In some embodiments, the hybrid polarizer further includes a quarter-wave plate disposed on either the hybrid polarizer portion or the reflective polarizer portion. In some embodiments, the reflective polarizer portion and the hybrid polarizer portion have substantially equal thicknesses. In some embodiments, the hybrid polarizer contains no layer thicker than 200 nm. The reflective polarizer portion and the hybrid polarizer portion may be separate packets. In some embodiments, the reflective polarizer portion and the hybrid polarizer portion are separated by a protective boundary layer. The reflective polarizer portion and the hybrid polarizer portion may include thermoplastic layers.

The present disclosure relates to a hybrid polarizer. More particularly, the present disclosure relates to hybrid polarizers having a reflective polarizer portion, an absorbing polarizer, and a hybrid polarizer portion. The reflective polarizer portion includes alternating high index layers and low index layers, where the reflective polarizer portion is substantially free of absorbing polarizer elements. The absorbing polarizer is disposed on the reflective polarizer portion. The hybrid polarizer portion is disposed on the absorbing polarizer and includes alternating high index layers and low index layers, where at least some of the high index layers of the hybrid polarizer portion include absorbing polarizer elements.

In another aspect, the present disclosure relates to a hybrid polarizer, comprising: a reflective polarizer portion, including alternating high index layers and low index layers, wherein the reflective polarizer portion is substantially free of absorbing polarizer elements; an absorbing polarizer disposed on the reflective polarizer portion; and a hybrid polarizer portion disposed on the absorbing polarizer, including alternating high index layers and low index layers, wherein at least some of the high index layers of the hybrid polarizer portion include absorbing polarizer elements.

In some embodiments, the hybrid polarizers may be included in a backlight having a viewing area. The hybrid polarizer is disposed such that the hybrid polarizer is closer to the viewing area than the reflective polarizer portion.

In another aspect, the present disclosure relates to a backlight having a viewing area, the backlight comprising the hybrid polarizer as defined herein, wherein the hybrid polarizer is disposed such that the hybrid polarizer portion is closer to the viewing area than the reflective polarizer portion.

## Brief Description of the Drawings

FIG. 1 is a cross sectional elevation view of a prior art hybrid polarizer.

FIG. 2 is an exploded cross sectional elevation view of a hybrid polarizer.

FIG. 3 is a graph showing 90° luminance cross sections for an exemplary hybrid polarizer and two comparative polarizers.

FIG. 4 is a graph showing 135° luminance cross sections for an exemplary hybrid polarizer and a comparative polarizer.

## Detailed Description

Hybrid polarizers may be used in several types of display devices, such as liquid crystal display devices (LCDs) and organic light emitting diode (OLED) based displays. They can function as a replacement for high performance absorbing polarizers on either the viewer side or the rear side of a display panel. "Hybrid" refers to the polarizer's functionality including elements from each of reflecting and absorbing polarizers. Because these functions may be combined into a single construction, hybrid polarizers may result in thinner optical stacks, backlights, and displays than would otherwise be required with separate reflective polarizing and absorptive polarizing elements. Hybrid polarizers may function not only as providing contrast to a display panel, but also providing polarization recycling for brightness enhancement.

Certain hybrid polarizers have previously been described in, for example, U.S. Patent No. 7,826,009 (Weber et al.). These hybrid polarizers include an absorbing element having a first major surface and a second major surface, a first reflective polarizer disposed on the first major surface of the absorbing element, and a second reflective polarizer disposed on the second major surface of the absorbing element. The basic construction of one embodiment of the hybrid polarizer described in Weber et al. is shown in FIG. 1. FIG. 1 is a cross sectional elevation view of prior art hybrid polarizer **100**, which includes first reflective polarizer **110** having alternating layers of high index layer **112** and low index layer **114**, second reflective polarizer **120** having alternating layers of high index layer **122** and low index layer **124**, and absorbing element **130**. Note that for a reflective polarizer having birefringent layers such as those described in this disclosure, "high index" and "low index" layer refer to the different in refractive index along one of the in-plane axes, because in many cases the other in-plane refractive index

will be the same or similar between the layers. Absorbing element may be an absorbing polarizer, including an absorbing polarizer such as a polyvinyl alcohol film including absorbing dyes.

Because of the inclusion of the absorbing element, prior art hybrid polarizer **100** may be thicker than desired. Further, the absorbing element may not be possible to assemble or orient in the same manufacturing process as the reflective polarizers, requiring one or more lamination steps.

What is claimed is:

1. A hybrid polarizer, comprising:

a reflective polarizer portion, including alternating high index layers and low index layers, wherein the reflective polarizer portion is substantially free of absorbing polarizer elements; and

a hybrid polarizer portion disposed on the reflective polarizer portion, including alternating high index layers and low index layers, wherein each of the high index layers of the hybrid polarizer portion include absorbing polarizer elements.

2. The hybrid polarizer of claim 1, wherein the absorbing polarizer elements are dyes.

3. The hybrid polarizer of claim 2, wherein the dyes are polarizing dyes.

4. The hybrid polarizer of claim 1, further comprising an absorbing polarizer disposed on the hybrid polarizer portion.

5. The hybrid polarizer of claim 1, further comprising a quarter-wave plate disposed on either the hybrid polarizer portion or the reflective polarizer portion.

6. The hybrid polarizer of claim 1, wherein the reflective polarizer portion and the hybrid polarizer portion have substantially equal thicknesses.

7. The hybrid polarizer of claim 1, wherein the hybrid polarizer contains no layer thicker than 200 nm.

8. The hybrid polarizer of claim 1, wherein the reflective polarizer portion and the hybrid polarizer portion are separate packets.

9. The hybrid polarizer of claim 4, wherein the reflective polarizer portion and the hybrid polarizer portion are separated by a protective boundary layer.

10. The hybrid polarizer of claim 1, wherein the reflective polarizer portion and the hybrid polarizer portion include thermoplastic layers.

11. A hybrid polarizer, comprising:

a reflective polarizer portion, including alternating high index layers and low index layers, wherein the reflective polarizer portion is substantially free of absorbing polarizer elements;

an absorbing polarizer disposed on the reflective polarizer portion; and

a hybrid polarizer portion disposed on the absorbing polarizer, including alternating high index layers and low index layers, wherein at least some of the high index layers of the hybrid polarizer portion include absorbing polarizer elements.

12. A backlight having a viewing area, the backlight comprising the hybrid polarizer of either claim 1 or 11, wherein the hybrid polarizer is disposed such that the hybrid polarizer portion is closer to the viewing area than the reflective polarizer portion.