# ASYMMETRIC TURNING FILM WITH MULTIPLE LIGHT SOURCES

## Background

Turning films are used in many display and lighting applications to change the angular distribution of light. Turning films generally have features which operate by refracting and/or reflecting light. Turning films may be used in conjunction with light sources to provide a desired light output.

## Summary

In one aspect, the present disclosure relates to an optical system. The optical system includes a first light source and a second light source having differently orientated light distributions, an asymmetric turning film including a first major surface and a second major surface, where the first major surface is substantially smooth and the second major surface includes a plurality of microstructures each having a first face having a first shape and a second face having a different second shape, and a polarizer, where light from the first light source is preferentially reflected by the first face but not the second face and where light from the second light source is preferentially reflected by the second face but not the first face, and where the asymmetric turning film is laminated to the polarizer. In some embodiments, the optical system further includes a lightguide configured to transport light from at least one of the first light source and the second light source. The optical system may include a second turning film disposed on the opposite side of the lightguide from the first asymmetric turning film. In some embodiments, the second turning film may be an asymmetric turning film. In some embodiments, the asymmetric turning film has a plurality of microstructures each having a third face having a third shape and a fourth face having a different fourth shape, where light from the first light source is preferentially reflected by the third face but not the fourth face and light from the second light source is preferentially reflected by the fourth face but not the third face.

In another aspect , the present disclosure relates to an optical system, comprising a first light source and a second light source having differently oriented light distributions;

a first lightguide configured to transport light from at least one of the first light source and the second light source;

a second lightguide configured to transport light from at least one of the first light source and the second light source; and

an asymmetric turning film comprising a first major surface and a second major surface, wherein the first major surface is substantially smooth and the second major surface comprises a plurality of microstructures each comprising a first face having a first shape and a second face having a different second shape;

wherein light from the first light source is preferentially reflected by the first face but not the second face;

wherein light from the second light source is preferentially reflected by the second face but not the first face; and

wherein the first lightguide and the second lightguide are stacked.

In some embodiments, the lightguide is wedge-shaped. In some embodiments, the optical system further includes a second lightguide configured to transport light from at least one of the first light source and the second light source. In some embodiments, the lightguide and the second lightguide are stacked. In some embodiments, the first shape is substantially flat and the second shape is substantially curved. In some embodiments, each of the plurality of microstructures is the same lateral cross-sectional shape. In some embodiments, both the first shape and the second shape are substantially flat. In some embodiments, both the first shape and the second shape are substantially curved.

In some embodiments, the optical system each microstructure of the plurality of microstructures further includes a third face having a third shape, where either light from the first light source is preferentially reflected by the first face and the third face but not the second face or light from the second light source is preferentially reflected by the second face and the third face but not the first face. In some embodiments, the optical system further includes a second plurality of microstructures, each including a third face having a third shape and a fourth face having a different fourth shape, where the third face preferentially reflects light from the first light source but not the second light source, where the fourth face preferentially reflects light from the second light source but not the first light source, and where at

least two of the first shape, the second shape, the third shape, and the fourth shape are different. In some embodiments, the second major surface of the asymmetric turning film includes at least one of an antireflective coating or an antireflective structured surface. In some embodiments, at least one of the first face or the second face includes a sawtooth or sinusoidal surface. In some embodiments, the plurality of microstructures includes linear microstructures.

In some embodiments, the optical system has two display modes, where in the first mode, only the first light source emits light, and in the second mode, only the second light source emits light. In some embodiments, the optical system has a third mode, where in the third mode, both the first light source and the second light source emits light. In some embodiments, at least one of the first light source and the second light source includes a plurality of LEDs. In some embodiments, at least one of the first light source and the second light source emits substantially white light. In some embodiments, at least one of the first light source and the second light source emits non-white light.

In another aspect, the present disclosure relates to an optical system including an asymmetric turning film having a display surface and two display modes, where in the first mode, the display surface emits light having a first characteristic set of viewing angles, and where in the second mode the display surface emits light having a second characteristic set of viewing angles, where the first characteristic set of viewing angles and the second characteristic set of viewing angles have different widths.

There is also disclosed a luminaire including the optical system as described.

There is also disclosed a display including the optical system as described.

## Brief Description of the Drawings

FIG. 1 is a schematic side elevation cross-section of an asymmetric turning film with multiple light sources.

FIGS. 2A, 2B, and 2C are a series of cross-sections showing exemplary face types for the microstructures of the asymmetric turning film of FIG. 1.

FIG. 3 is a schematic side elevation cross-section showing the operation and general optical principles of the asymmetric turning film and multiple light sources of FIG. 1.

FIG. 4 is a schematic side elevation cross-section showing first and second sets of characteristic viewing angles.

FIG. 5 is another schematic side elevation cross-section showing first and second sets of characteristic viewing angles.

FIG. 6 is another schematic side elevation cross-section showing first and second sets of characteristic viewing angles.

## Detailed Description

Asymmetric turning films may be used in conjunction with multiple light sources to provide useful or desirable output distributions of light. For example, the asymmetric turning films may have faces that reflect light from one light source but not another. In some embodiments the asymmetric turning films may have a plurality of microstructures or prisms, each having at least a first and second face. If these faces are shaped or orientated differently with respect to corresponding light sources (i.e., a