Claims

1. A waveguide display element comprising

- a waveguide body,
- an in-coupling grating arranged to the waveguide body,

two first exit pupil expander gratings on different sides of the in-coupling grating corresponding to said separate directions,

two second exit pupil expander gratings at least partly on different sides of the out-coupling grating that are adapted to receive light from the two exit pupil expander gratings, respectively and

a single out-coupling grating adapted to receive light from at least one of the second exit pupil expander gratings,

wherein:

the in-coupling grating is configured to couple incoming light into the waveguide body into two separate directions using opposite diffraction orders for splitting the field of view of the incoming light,

the grating is further ~~being~~ configured such that said coupling takes place only at wavelengths below a threshold wavelength residing in the visible wavelength range, ~~wherein~~

the in-coupling grating has a period, which is short enough to prevent coupling of wavelengths above said threshold wavelength into the waveguide body,

and

at least part of the light is adapted to travel from the first exit pupil expander gratings to the second exit pupil expander gratings via a region of the waveguide layer on which the out-coupling grating is located, and further back to the out-coupling grating.

2. The element according to claim 1, wherein the threshold wavelength is in the range of 500-540 nm, ~~or~~ 620-660 nm, ~~such as~~ 510-530 nm, or 630-650 nm, or is ~~for example~~ 520 nm or 640 nm.

3. The element according to ~~any of the preceding~~ claim~~s~~ 1, wherein the waveguide body has an index of refraction higher than 1.8~~, such as 1.9 - 2.1~~.

~~4. The element according to any of the preceding claims, further comprising~~

- ~~two first reflective gratings or first exit pupil expander gratings on different sides of the in-coupling grating corresponding to said separate directions,~~
- ~~at least one second exit pupil expander grating adapted to receive light from the two first reflective gratings or exit pupil expander gratings, respectively,~~
- ~~a single out-coupling grating adapted to receive light from the at least one second exit pupil expander grating.~~

~~5. The element according to claim 4, comprising a single second exit pupil expander grating.~~

~~6. The element according to claim 5, comprising two second exit pupil expander gratings at least partly on different sides of the out-coupling grating.~~

~~7.~~4. A waveguide display element comprising:

a waveguide body,

an in-coupling grating arranged to the waveguide body,

two first exit pupil expander gratings on different sides of the in-coupling grating corresponding to said separate directions,

two second exit pupil expander gratings at least partly on different sides of the out-coupling grating that are adapted to receive light from the two exit pupil expander gratings, respectively, and

a single out-coupling grating adapted to receive light from at least one of the second exit pupil expander gratings,

wherein:

the in-coupling grating is configured to couple incoming light into the waveguide body into two separate directions using opposite diffraction orders for splitting the field of view of the incoming light,

the grating is further configured such that said coupling takes place only at wavelengths below a threshold wavelength residing in the visible wavelength range, and

the in-coupling grating has a period, which is short enough to prevent coupling of wavelengths above said threshold wavelength into the waveguide body, and

~~The element according to claim 6, wherein~~ the second exit pupil expander gratings extend to the opposite side of the out-coupling grating, as seen from the first exit pupil expander gratings.

~~8. The element according to claim 6 or 7, wherein at least part of the light is adapted to travel from the first exit pupil expander gratings to the second exit pupil expander gratings via a region of the waveguide layer on which the out-coupling grating is located, and further back to the out-coupling grating.~~

~~9.~~5. The element according to ~~any of the preceding~~ claim~~s~~ 1, wherein the in-coupling gratings are adapted to couple light into the waveguide layers using the first positive and first negative diffraction orders, such as the first positive and negative transmission diffraction orders.

~~10.~~6. A waveguide stack for diffractive displays, the stack comprising

at least two waveguide layers, wherein at least one of the waveguide layers is a waveguide element according to ~~any of the preceding~~ claim~~s~~ 1.

~~11.~~7. A waveguide stack for diffractive displays, ~~T~~the stack ~~according to claim 10,~~ comprising:

at least three waveguide layers at least two of which are according to ~~any of~~ claim~~s~~ 1 ~~- 9~~ and have different threshold wavelengths.

~~12.~~8. The stack according to claim ~~11~~7, wherein:

– a first of the waveguide layers comprises a first in-coupling grating adapted to couple light to a first waveguide layer only below a first threshold wavelength,
– a second of the waveguide layers comprises a second in-coupling grating adapted to couple light to a second waveguide layer only below a second threshold wavelength higher than the first threshold wavelength, and
– a third waveguide layer comprises an in-coupling grating configured to couple light to a third waveguide layer above said second threshold wavelength,

the stack further comprising:

– a first wavelength filter element arranged between the first and the second waveguide layer and arranged to prevent wavelengths below the first threshold wavelength entering the second in-coupling grating,

– a second wavelength filter element arranged between the second and the third waveguide layer and arranged to prevent wavelengths below the second threshold wavelength entering the third in-coupling grating.

~~13.~~9. The stack according to claim ~~12~~8, wherein the first and/or second wavelength filter is a reflective filter or absorptive filter.

~~14.~~10. A see-through display device comprising:

– a waveguide display element ~~or waveguide stack~~ according to ~~any of the preceding~~ claim~~s~~ 1, and

- a waveguide display image projector directed at the in-coupling grating and being capable of presenting a multicolor image comprising wavelengths both above and below said threshold wavelength.

11. The element according to claim 2, wherein the waveguide body has an index of refraction higher than 1.8, such as 1.9 - 2.1.

12. The element according to claim 4, wherein at least part of the light is adapted to travel from the first exit pupil expander gratings to the second exit pupil expander gratings via a region of the waveguide layer on which the out-coupling grating is located, and further back to the out-coupling grating.

13. The element according to claim 1, wherein the waveguide body has an index of refraction of from about 1.9 to about 2.1.