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**Matt-glass pane, as well as a whiteboard with a matt-glass
pane**

5 Description

The invention relates in general to matt-glass panes and to
devices provided with them, such as whiteboards, light tables
as well as partitions, in particular wall parts in the
10 sanitary field, and in particular the invention also relates
to matt-glass panes with an improved surface, and to their
uses.

Matt-glass panes are used as whiteboards or often also for
15 lighting purposes, when the aim is to achieve uniform,
indirect lighting with as few shadows as possible. Panes such
as these can be used inter alia for lighting through
photographic films, or as an illuminated illustration surface
or writing surface.

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The invention is in this case based on the object of
providing matt-glass panes with improved characteristics,
preferably improved surface characteristics.

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This object is achieved in a very highly surprisingly simple
manner just by the subject matter of the independent Claims 1
and 18.

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Advantageous refinements and developments of the invention
are specified in the dependent claims.

The invention accordingly provides a matt-glass pane which comprises a matt-glass substrate with an antireflective layer on at least one side of the matt-glass substrate. A
5 corresponding method for production of a matt-glass pane such as this comprises, for this purpose, the steps of:

- provision or production of a matt-glass substrate, and
- coating of at least one of the sides of the matt-glass substrate with an antireflective layer.

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Antireflective layers are normally used to achieve a particularly undisturbed clear view through clearly transparent substrates. The use of an antireflective layer for a milky glass which in contrast is actually not clearly
15 transparent, as proposed according to the invention, thus initially appears to be nonsense.

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However, the inventors have surprisingly found that an antireflective layer can achieve particularly advantageous effects even on a matt-glass substrate.

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In one particularly preferred refinement of the invention, an antireflective layer is in this case preferably arranged on a useful side or front face. The expression the useful side or
front face of the pane is used in the following text to mean
that side which faces the viewer or user. Applications are,
of course, also possible in that both sides of the matt-glass pane are useful sides.

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One application of a matt-glass pane according to the invention such as this is a whiteboard, or a similar apparatus in which, for example, fibre pens are used to write or paint on a surface. In this case, it has surprisingly been found that an antireflective layer produces an improved,
35 smoother writing behaviour. It has furthermore also been

found that it is easy to clean a pane which has been coated in this way. A whiteboard such as this can thus not only be written on better, but the writing can also be erased more easily.

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For the purposes of the invention, the expression whiteboard is not intended to be restricted to white translucent or reflective boards, but is also intended to cover coloured boards which, for example, have a specific colour by means of pigments in the board or in the reflective layer, preferably when this is a sol-gel reflective layer, or by interference in the reflective layer. However, the word white as part of the expression whiteboard defines the fact that at least a portion of the visible spectrum is transmitted and/or reflected.

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The same also applies to the use of other appliances, as in a light box, in particular for analysis of X-ray images, and for light panels or drawing boards. Here, in the same way as in the case of a whiteboard as well, there is the additional effect that interfering reflections from light sources are reduced, which distract the observer and can make the objects harder to see on the useful surface, or can make the inscriptions that are applied to them harder to see. This results in a major advantage: since the reflections on the front face still have a disturbing effect, the antireflective layer for the first time allows an effectively matt appearance with a considerably better surface quality at the same time, with the capability to make considerably better use of the surface. The capability to identify inscriptions or structures on images is considerably improved. Particularly in the medical field, this frequently also makes it possible to better identify fine differences, and to differentiate them.

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The coating of at least one of the faces of the matt-glass substrate with an antireflective layer may comprise, for example, coating with a sol-gel layer. Pyrolytic deposition or vacuum deposition, for example by the sputtering, chemical vapour-phase deposition or vapour deposition, is likewise possible.

The matt-glass pane may also be coated with an antireflective layer on both sides. This is advantageous, for example, when both sides of the pane are used as useful sides. This may be the case, for example, when used in the bath or sanitary field. One example of this is the use of matt-glass panes according to the invention as wall elements for shower cubicles or other translucent elements in the field of architecture. In this case, the antireflective layer not only makes cleaning easier but, in addition, it also achieves an aesthetic effect as a result of the reduced reflections from light sources arranged in the surrounding area.

One particularly preferred embodiment of the invention is based on the matt-glass substrate comprising a two-layer glass with a clearly transparent, preferably colourless, base glass and a milky casing layer. Glasses such as these, such as the glass which is marketed under the trade name OPALIKA®, are distinguished by optical characteristics which can be achieved only with difficulty by other transparent materials. A glass such as this thus in general appears as a uniformly white surface. Even when a glass such as this is back-lit, the emission characteristic is virtually isotropic, so that uniform, indirect illumination with few shadows can be achieved for lighting bodies.

In further preferred embodiments, the matt-glass pane is illuminated from the front, for example for the projection of

images onto the matt pane, or the matt-glass pane is back-lit and is illuminated from the front, thus making it possible to produce a very pleasant match between external light and one's own lighting, and the contrasts in a projected image are freely variable while, wherever desired for room dividers, allowing internal architectonic accents to be achieved which offer wide degrees of design freedom with the intensity and colour of the light used, allowing high flexibility in use.

The pane according to the invention may, for example, be mobile, in particular being fitted to a ceiling such that it can pivot, where it can scarcely be perceived owing to its preferred wide colour as is typical for ceilings, and can be folded down, moved down or pivoted down manually or by motor, by a mechanism that is known to those skilled in the art, in order in this way to be used as a whiteboard and/or for front or background projection both in the home consumer field and in the professional field. Whiteboards such as these go well beyond the previous usage forms, owing to their versatility.

Due to one development of this embodiment of the invention, the antireflective layer and the casing layer are arranged on opposite sides of the milky glass substrate. If the antireflective layer is applied to the useful side, then the casing layer is then located on or at the rear face of the pane, on the assumption that the pane is not viewed on both sides. However, according to another development, it is also possible to arrange the antireflective layer on the casing layer. In this embodiment as well, an antireflective layer may, of course, be applied on both sides.

According to yet another embodiment of the invention, the matt-glass substrate has a matted surface. This is a particularly simple way to achieve a matt-glass effect.

However, surfaces such as these are comparatively sensitive to dirt. In this case, the antireflective layer and the matted surface are preferably arranged on opposite sides. If the side of the matt-glass pane with the antireflective layer is used as the useful side, then this avoids the matted rear face quickly becoming dirty. Furthermore, this provides a smooth useful side.

Further simple options for production of a matt-glass substrate are to provide a substrate with a scattering sheet, or to paint or to coat the substrate with a scattering layer.

According to yet another development of the invention, the matt-glass substrate may comprise a laminated glass. In particular, the matt-glass substrate may for this purpose comprise a clear-glass pane and a matt-glass pane, which are laminated to one another. Laminated glasses may in particular also be in the form of safety glass. By way of example, a two-layer glass with a milky casing layer can be laminated together with a further pane when, for example, there are stringent requirements for fragment safety. It is also possible to use a matt plastic film between the glasses, and this is part of one preferred embodiment of the invention.

PVB sheet laminates as well as casting resins which can be used for these laminates are particularly highly suitable for this purpose.

The matt-glass substrate preferably also comprises a glass substrate. However, it is quite possible for other materials also to be used instead of a glass substrate or in addition to it. Thus, for the purposes of the invention, the expression "a matt-glass substrate" does not necessarily mean a glass substrate, but in fact in general a substrate which exhibits a typical matt-glass effect. In other words, for the

purposes of the invention, a matt-glass substrate represents a substrate which is translucent, but not transparent, irrespective of the material of the substrate.

- 5 Alternatively or in addition to a typical suitable glass substrate, such as a float-glass or down-draw glass substrate, the substrate can thus also be composed of other materials, such as a plastic substrate.
- 10 A glass from a drawing process, in particular an updraw glass substrate, is also preferably used.

The use of an organic glass, that is to say of a plastic substrate, is worthwhile, for example, where the weight of
15 the substrate is a significant factor. The antireflective layer results in a smooth surface which behaves substantially in the same way as glass on the plastic and gives the plastic substrate at least a considerable proportion of the positive characteristics of glass, such as reduced inward diffusion of
20 dyes, better cleaning capabilities, chemical resistance as well as ageing and UV-resistance. This opens up new fields of application for plastic substrates such as these, for example in the case of architecture glass, in the sanitary field as well as in the case of cladding or as part of furniture
25 items, in which the ageing and UV-resistance and the improved chemical and mechanical resistance to cleaning and polishing agents result in major advantages over uncoated substrates.

In order to influence the characteristics of a matt-glass
30 pane in terms of making it better to write on, even a simple single-layer antireflective layer is surprisingly effective. However, multilayer antireflective layers can also always be used. This is worthwhile, for example, where disturbing reflections are intended to be avoided.

Antireflective layers, as can be used for a matt-glass pane according to the invention, typically comprise inorganic oxide layers which, because they their refractive index and their optical thickness differ from those of adjacent materials, result in an antireflective interference effect. Suitable materials are, for example, titanium oxide, niobium oxide or tantalum oxide as high-refractive-index materials, as well as silicon oxide as a low-refractive-index material. In addition to the resultant antireflective interference effect, a different surface character is additionally also achieved and leads, inter alia, to the surface being better to write on, in particular with fibre pens.

The invention will be explained in more detail in the following text using exemplary embodiments and with reference to the drawings. In this case, identical reference signs in the figures denote identical or similar parts. In the figures:

Figure 1 shows a schematic view of a first exemplary embodiment of a matt-glass pane according to the invention,

Figure 2 shows a variant of the exemplary embodiment illustrated in Figure 1 with a two-layer glass,

Figures 3 and 4 show modifications of the example illustrated in Figure 2,

Figure 5 shows an example with a matted surface in order to produce a milky-glass effect,

Figure 6 shows an example with a composite-glass substrate, and

Figures 7 to 10 show examples of use of panes such as these.

Figure 1 shows a cross-sectional view of a first exemplary embodiment of a matt-glass pane according to the invention

which comprises a substrate 2 in the form of a pane, which in this exemplary embodiment has three-dimensionally light-scattering structures, which give the substrate a translucent but not transparent appearance, in the form of a milky glass. The material used in this case is not necessarily glass and in fact other translucent materials can also be used, such as suitable polymers.

The substrate has a useful side or front face 4 and a rear face 6. In this case, according to the invention, an antireflective layer 8 is applied to the useful side 4.

The antireflective layer 8 may have been deposited, for example, by means of sol-gel coating, pyrolytic coating, sputtering or vapour deposition on the useful side 4 of the substrate 2. Admittedly, at first glance, it does not appear to be worthwhile providing a pane which is not clearly transparent with an antireflective coating, but, surprisingly, it has been found that a layer such as this results in highly advantageous effects on a matt translucent substrate. For example, it has surprisingly been found that the useful side can be written on with pens considerably better than is the case with an untreated surface. Furthermore, for example when the matt-glass substrate is used as an illuminated surface for through-lighting and viewing of objects arranged on it, reflections from other light sources can disturb and distract the viewer. One thought in this case, among others, is to use a substrate such as this for viewing and through-lighting of photographic images. It is also possible, for example, for the antireflective layer to be coloured, so that the colour tone of a light source arranged at the rear is changed.

The antireflective layer system may additionally comprise defined filter components in order to provide colouring in

this way. Filter components such as these may comprise interference layers of defined thickness and/or colouring pigments.

- 5 In an alternative refinement, the matt-glass pane is illuminated from the front, or the matt-glass pane is back-lit and is illuminated from the front.

10 In a further refinement according to the invention, the matt pane may advantageously be part of an illumination device with a rear-face illumination device or a rear-face projection device, or the matt-glass pane may alternatively be illuminated from the front and may advantageously be part of an illumination device with a front illumination device or
15 a front projection device.

Figure 2 shows a variant of the exemplary embodiment illustrated in Figure 1. In this variant, a two-layer glass, in particular a machine-drawn two-layer glass, is used as the
20 substrate 2. This two-layer glass comprises a clearly transparent, preferably colourless, base glass 9 which is used as the mount material for a preferably thin milky casing layer 10 in order to produce diffuse light with few shadows. In the example shown in Figure 2, the casing layer 10 is
25 arranged on the rear face 6 of the substrate, with the antireflective layer 8 being applied to the opposite useful side.

In the modification illustrated in Figure 3, the casing layer
30 10 is arranged on the useful side, and the antireflective layer 8 is deposited on the casing layer 10. Figure 4 shows a further modification of the examples shown in Figures 2 and 3. In this development, the casing layer 10 is likewise arranged on the rear face, in the same way as in the example
35 shown in Figure 2. In addition, a further antireflective

layer 8 is applied to the rear face 6. This not only improves the characteristics of the useful side, but also increases the amount of light input from a light source at the rear through the antireflective layer.

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In the example shown in Figure 5 and as a modification to the already explained examples, the rear face 10 is in the form of a matted surface 12, in order to produce a milky glass effect. The matting can be provided, for example, by etching or sandblasting. This exemplary embodiment is a particularly cost-effective alternative, as is the application of a matted or scattering sheet.

On the other hand, the matted surface is comparatively sensitive to dirt which can adhere to the surface. Alternatively or in addition to a matted surface or a scattering sheet, the rear face can also be painted or coated, for example, with a scattering layer.

In the example shown in Figure 6 a laminated glass is used as the substrate 2. In this case, the substrate 2 comprises a clear-glass pane 22 and a matt-glass pane 23, which are laminated to one another by means of a sheet 24. It is likewise also possible to use a matt translucent sheet 24, which then produces a matt-glass effect. In this case, both panes 22, 23 may then also be clear-glass panes.

A matt sheet which is preferably composed of plastic can accordingly advantageously be arranged in the laminated glass and/or also on the laminated glass, as illustrated by way of example in Figure 6, in which case the expression "arranged on the laminated glass" means that it is applied to one or else both sides of the laminated glass and is retrospectively fitted to conventional panes, for example to windows or doors, or else to motor vehicle doors, in particular to

emergency-service vehicles.

When a pane which is matted on the rear face, which means a pane which is matted on the side facing away from the user, is arranged in the laminated glass or on the laminated glass, this smooth pane, which is relatively easy to clean, may point outwards.

A laminated glass substrate such as this may, of course, also have more than two panes. A substrate such as this may then advantageously also be in the form of safety glass.

Glasses or safety glasses such as these may be made from architectural glass, in particular for cladding internal or external walls of building parts, a room divider, a wall part or a wall element.

It is also within the scope of the invention for the glass or this product to be a door or a part of a door, or else a window or a part of a window.

It is also advantageous for the glass or the product according to the invention to be a part of a piece of furniture, in particular as glazing or protection against viewing, or is arranged as a resting surface or writing surface in a panel of a piece of office furniture, in particular a writing desk.

In a further refinement, the product may also be a front attachment pane, in particular for monitors or display devices.

The following figures show products for which matt-glass panes according to the invention can be used.

Figure 7 shows a whiteboard with a coated matt-glass pane 1, as has been described, for example, with reference to Figures 1 to 6. The matt-glass pane 1 is in this example held on a stand 17. The useful side 4 of the matt-glass pane 1 with the antireflective layer is in this case used as a writing surface. Back-lighting is also provided for the matt-glass pane 1, in order to create an illuminated writing surface.

Figure 8 shows a light box 19 as is used, for example, for viewing and evaluation of X-ray images. The light box 19 likewise comprises a back-lit matt-glass pane 1, which is held in a frame 21. X-ray images 20 can be suspended in a holding apparatus on the frame, so that they are arranged in front of the antireflective useful surface 4 of the matt-glass pane 1, and can be illuminated through the back-lit matt-glass pane 1.

Figure 9 shows a light panel 25 as a further example of the use of matt-glass panes as are illustrated by way of example in Figures 1 to 6. The light panel 25 may also be in the form of a drawing panel or drawing board. A matt-glass pane 1 with an antireflective layer according to the invention on the useful side or front face 4 is incorporated in the working surface 26 of the light panel. In this example as well, the matt-glass pane is back-lit. A light panel 25 such as this may be used, for example, for working on film negatives or slide positives. Light panels such as these are also used for checking master prints, for example for offset printing.

Figure 10 shows an example from the sanitary or bathroom field, in which matt-glass panes 1 according to the invention are used for a shower cubicle 30. In this example, matt-glass panes are used in particular for a door element 33 and a wall element 35 which are fitted to the shower cubicle 31. In this example, there are no particular useful sides or rear faces

of the matt-glass panes. In this case, by way of example, it is advantageous to apply antireflective layers 8 to both sides of the panes. Matt-glass panes 1 as illustrated in Figure 4 can be used for this purpose.

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The antireflective layers result in a number of advantages for an application such as this. For example, the optical appearance is changed in comparison to panes without any antireflective layer as a result of the reduction in reflections. Furthermore, it has been found that the antireflective layers also make cleaning easier.

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It is obvious to a person skilled in the art that the invention is not restricted to the exemplary embodiments described above but in fact can be varied in many ways. In particular, the features of the individual exemplary embodiments can also be combined with one another.

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Depending on the embodiment and application, further layers, such as a further layer which makes cleaning easier and reduces dirt can be provided according to the invention, as is offered and marketed, for example, by Schott AG under the name "PearlFinish", or from other companies under the name "Clear Shield".

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For the purposes of the invention, the expression "glass" is not just restricted to inorganic glasses in the conventional sense, but is also intended to cover organic glasses, in particular essentially non-crystalline and at least partially amorphous, preferably transparent dielectric material, in particular plastics, in which the crystal component, which means the crystal component determined by X-ray diffraction, is less than 90% by weight of the plastic.

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In the case of plastics which are not transparent or are only slightly transparent, this crystalline component may also be greater without in this way losing the positive surface improvements, such as the antireflective layer being easier
5 to write on and to clean.

In particular, less-transparent substrates are also excellently suitable for use as protection against viewing and glare, for example as front attachment panes for
10 monitors.

Furthermore, instead of plastic with surface matting, it is also possible to use pigmented plastic or plastic provided with embedded particles.
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List of Reference Symbols:

	1	Coated matt-glass pane
	2	Substrate
5	4	Useful side, front face
	6	Rear face
	8	Antireflective layer
	9	Colourless base glass
	10	Milky casing layer
10	12	Matted surface
	15	White wall panel
	17	Stand
	19	Light box
	20	X-ray image
15	21	Frame
	22	Clear-glass pane
	23	Matt-glass pane
	24	Sheet
	25	Light panel
20	26	Working surface of 25
	30	Shower cubicle
	31	Shower tub
	33	Door element of 30
	35	Fixed element of 30
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Patent Claims

1. Matt-glass pane, comprising a matt-glass substrate and
an antireflective layer on at least one side of the
matt-glass substrate.
2. Matt-glass pane according to Claim 1, characterized in
that an antireflective layer is arranged on a useful
side.
3. Matt-glass pane according to Claim 1 or 2, characterized
in that the matt-glass pane is coated with an
antireflective layer on both sides.
4. Matt-glass pane according to one of the preceding
claims, characterized in that the matt-glass substrate
comprises a two-layer glass with a clearly transparent,
preferably colourless, base glass and a milky casing
layer, which in particular reflects white or colours
diffusely.
5. Matt-glass pane according to Claim 4, characterized in
that the antireflective layer and the casing layer are
arranged on opposite sides of the milk-glass substrate.
6. Matt-glass pane according to Claim 4 or 5, characterized
in that the antireflective layer is arranged on the
casing layer.
7. Matt-glass pane according to one of the preceding
claims, characterized in that the matt-glass substrate
has a matted surface.
8. Matt-glass pane according to Claim 7, characterized in
that the antireflective layer and the matted surface are

arranged on opposite sides.

9. Matt-glass pane according to one of the preceding claims, characterized in that the matt-glass substrate comprises a substrate provided with a scattering film.
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10. Matt-glass pane according to one of the preceding claims, characterized in that the matt-glass substrate comprises a substrate which is painted or coated with a scattering layer.
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11. Matt-glass pane according to one of the preceding claims, characterized in that the matt-glass substrate comprises a laminated glass.
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12. Matt-glass pane according to Claim 11, characterized in that the matt-glass substrate comprises a clear-glass pane and a matt-glass pane, which are laminated to one another.
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13. Matt-glass pane according to Claim 11 or 12, characterized in that a matt film, which is preferably composed of plastic, is arranged in the laminated glass or on the laminated glass.
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14. Matt-glass pane according to Claim 11, 12 or 13, characterized in that a pane which has been matted on the rear face is arranged in the laminated glass or on the laminated glass.
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15. Matt-glass pane according to one of the preceding claims, characterized in that the antireflective layer is in the form of a multilayer antireflective layer.

16. Matt-glass pane according to one of the preceding claims, characterized in that the matt-glass substrate comprises a glass substrate.
- 5 17. Matt-glass pane according to one of the preceding claims, characterized in that the matt-glass substrate comprises at least one glass from a drawing process, in particular an updraw glass substrate.
- 10 18. Matt-glass pane according to one of the preceding claims, characterized in that the matt-glass substrate comprises at least one float-glass substrate.
- 15 19. Matt-glass pane according to one of the preceding claims, characterized in that the matt-glass substrate comprises at least one plastic substrate.
20. Method for production of a matt-glass pane, comprising the following steps:
- 20 - provision or production of an organic or inorganic matt-glass substrate,
- coating of at least one of the faces of the organic or inorganic matt-glass substrate with an antireflective layer.
- 25 21. Method according to Claim 20, characterized in that the coating of at least one of the faces of the matt-glass substrate with an anti-reflective coating comprises coating with a sol-gel layer.
- 30 22. Method according to Claim 20 or 21, characterized in that the coating of at least one of the faces of the matt-glass substrate with an antireflective layer comprises pyrolytic deposition of a layer.

23. Method according to one of the preceding claims,
characterized in that the coating of at least one of the
faces of the matt-glass substrate with an antireflective
layer comprises vacuum deposition of at least one layer.
24. Method according to Claim 23, characterized in that the
vacuum deposition of at least one layer comprises the
deposition of the layer by sputtering, chemical
vapour-phase deposition or vapour deposition.
25. Method according to one of the preceding claims,
characterized in that a multilayer antireflective layer
is applied.
26. Product having a matt-glass pane according to one of the
Claims 1 to 19 or produced using a method according to
one of Claims 20 to 25, which preferably has a further
layer which eases cleaning and reduces dirt.
27. Product according to Claim 26, characterized in that the
product is a whiteboard, in which case a useful side of
the matt-glass pane, which is provided with an
antireflective layer, forms the writing surface of the
whiteboard.
28. Product according to Claim 27, characterized in that the
matt-glass pane is back-lit and is preferably part of an
illumination device with a rear-face illumination device
or a rear-face projection device.
29. Product according to Claim 27, characterized in that the
matt-glass pane is illuminated from the front and is
preferably part of an illumination device with a front
illumination device or a front projection device.

30. Product according to Claim 27, characterized in that the matt-glass pane is back-lit, and is illuminated from the front.

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31. Product according to Claim 27, characterized in that the product is a light box, in particular for viewing X-ray images.

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32. Product according to Claim 24, characterized in that the product is a light panel or a drawing board, with the useful side of the matt-glass pane being provided with an antireflective layer.

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33. Product according to Claim 27, characterized in that the product is a projection screen, in particular for viewing projected analogue or digital images.

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34. Product according to Claim 27, characterized in that the product is a part, in particular a wall part, of a shower cubicle.

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35. Product according to Claim 27, characterized in that the product is an architecture glass, in particular for cladding inner or outer walls of building parts.

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36. Product according to Claim 27, characterized in that the product is a room divider, a wall part or a wall element.

37. Product according to Claim 27, characterized in that the product is a door or a part of a door.

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38. Product according to Claim 27, characterized in that the product is a window or a part of a window.

39. Product according to Claim 27, characterized in that the product is a part of a piece of furniture, in particular as glazing or protection against viewing, or is arranged as a resting surface or writing surface in a panel of a piece of office furniture, in particular a writing desk.
40. Product according to Claim 27, characterized in that the product is a front attachment pane, in particular for monitors or display devices.
41. Use of antireflective layers for matt-glass panes.
42. Use of an antireflective matt-glass pane for a whiteboard.
43. Use of an antireflective matt-glass pane for a light box, in particular for viewing X-ray images or other images which are illuminated through them.
44. Use of an antireflective matt-glass pane for a light panel or a drawing board.
45. Use of an antireflective matt-glass pane for products for the bathroom or sanitary area, in particular for wall elements of shower cubicles.
46. Use of an antireflective matt-glass pane for products for illumination devices in front of test equipment, in particular for manual or automated visual testing of bottles.