secure a portion where irradiation is avoided in a body to be processed and irradiating the body to be processed with the split line beams.

Solution to Problem

[0006]

That is, according to a first aspect of the invention, a laser beam shielding member is described, ~~of~~ ~~a~~ the laser beam shielding member ~~of the present invention is a shielding member~~ shielding transmittance of full width of a short axis width of ~~part of~~ a laser beam in a line beam shape along a short axis direction in part of a long axis direction, and the laser beam is transmitted other than the shielding of full width of a short axis width within the range other than a long axis edge, to form a plurality of split line beams to be radiated on a body to be processed, wherein the shielding member is provided so that a shielding shape extends by a length which exceeding a short axis width of the laser beam, and the width shape of the shielding member changes stepwise or continuously in the length direction, part or the whole of the shielding member can perform sliding movement~~move~~ relatively in the line beam shape in a short axis width direction of the laser beam in the length direction with respect to a light path of the laser beam, and the shielding shape shielding the laser beam changes ~~in the line beam shape, and adjustment~~

~~of a shape of the split line beams can be performed~~ in accordance with the movement, and adjustment of a shape of the split laser beams can be performed.

~~A~~According to a second aspect of the invention, a laser beam shielding member is described, the laser beam shielding member shielding transmittance of full width of a short axis width of a laser beam in a line beam shape along a short axis direction in part of a long axis direction, and the laser beam is transmitted other than the shielding of full width of a short axis width, to form a plurality of split line beams to be radiated on a body to be processed, wherein the shielding member is provided so that part or the whole of the shielding member can perform a rotational movement relatively with respect to a light path of the laser beam in the line beam shape, and a shielding shape with respect to the laser beam changes in accordance with the movement, and adjustment of a shape of the split laser beams can be performed.~~of the present invention is the laser beam shielding member in the first aspect, wherein~~

In embodiments, the shielding member has a shape such that a shielding shape changes in accordance with the movement.

~~A third aspect of the laser beam shielding member of the present invention is the laser beam shielding member in the second aspect, wherein~~In embodiments, the shielding member has a shape such that the shielding

shape changes stepwise or continuously in accordance with the movement.

~~A fourth aspect of the laser beam shielding member of the present invention is~~In embodiments, ~~the laser beam shielding member in any one of the first to the third aspects, wherein~~ the movement includes sliding movement and/or rotational movement.

~~A fifth aspect of the laser beam shielding member of the present invention is the laser beam shielding member in any one of the first to the fourth aspects, wherein~~In embodiments, the adjustment of the shape of the line beam is adjustment of a length of the line beams in a long axis direction.

[0007]

According to a third aspect of the present invention, ~~A sixth aspect of~~ a laser processing device is described, the laser processing device ~~of the present invention~~ includes a laser light source configured to output a laser beam, an optical system configured to form the laser beam into a line beam shape and guide the laser beam to a body to be processed, a processed body holding unit configured to hold the body to be processed in preparation for irradiation of the laser beam, and the laser beam shielding member according to any one of the ~~first to the fifth aspects~~above embodiments of the present invention, wherein the laser beam shielding member is disposed so that a plurality of split line beams can be formed by shielding transmittance of full width of a short axis width of a laser beam along a short

axis direction in part of a long axis direction ~~part of the line beam~~ on a light path leading to the body to be processed held by the processed body holding unit, with the laser beam formed in the line beam shape being guided, and the laser beam is transmitted other than the shielding of full width of a short axis width within the range other than a long axis edge.

~~A seventh aspect of the laser processing device of the present invention is the laser processing device in the sixth aspect, wherein~~In embodiments, the shielding member can slidingly move and/or rotatingly move.

~~An eighth aspect of the laser processing device of the present invention is the laser processing device in the sixth or the seventh aspect, wherein~~In embodiments, the body to be processed has a laminated structure and separation processing is performed on the body to be processed.

~~A ninth aspect of the laser processing device of the present invention is the laser processing device in the sixth or the seventh aspect, wherein~~In embodiments, the body to be processed is a substrate having a semiconductor layer and the semiconductor layer is crystalized or a crystal of the semiconductor layer is activated.

~~A tenth aspect of the laser processing device of the present invention is the laser processing device in any one of the sixth to the ninth aspects, wherein~~In embodiments, the body to be processed is a plastic substrate.

~~An eleventh aspect of~~According to a fourth aspect of the invention, a laser beam irradiation method is described, the ~~a~~ laser beam irradiation method ~~of the present invention~~ includes forming a laser beam into a line beam shape, disposing a shielding member part or the

whole of which can move on a light path of the line beam to shield transmittance of part of the line beam and form a plurality of split line beams having a shape determined according to a position where the shielding member is disposed through the movement, and

irradiating a body to be processed with the split line beams.

[0008]

According to embodiments of the present invention, the line beam is split by the shielding member, and the body to be processed is irradiated with the split line beams. The shielding member can change the shape of the line beams after being split according to the movement, so that it is possible to obtain a plurality of irradiation patterns for the body to be processed.

It should be noted that the body to be processed can include various kinds of bodies which are processed by being irradiated with a laser beam in a line beam shape, and can include various kinds of bodies aimed at separation, crystallization, activation, or the like. To achieve the aims, examples of the body to be processed include a glass substrate and a plastic substrate having a semiconductor layer.

[0009]

Further, the laser beam formed in a line beam shape is not limited to a pulse oscillation laser beam, a continuous oscillation laser beam, or the like, and types of the laser are not particularly limited and can include gas laser, solid laser, semiconductor laser, or the like.

The shielding shape of the shielding member changes according to the movement, and can change the shape of the split line beams. The shielding shape which changes

Claims

[Claim 1]

A laser beam shielding member shielding transmittance of part of a laser beam in a line beam shape to form a plurality of split line beams to be radiated on a body to be processed,

wherein the shielding member is provided so that part or the whole of the shielding member can move relatively with respect to a light path of the laser beam in the line beam shape, and adjustment of a shape of the split line beams can be performed in accordance with the movement.

[Claim 2]

The laser beam shielding member according to claim 1, wherein the shielding member has a shape such that a shielding shape changes in accordance with the movement.

[Claim 3]

The laser beam shielding member according to claim 2, wherein the shielding member has a shape such that the shielding shape changes stepwise or continuously in accordance with the movement.

[Claim 4]

The laser beam shielding member according to any one of claims 1 to 3, wherein the movement includes sliding movement and/or rotational movement.

[Claim 5]

The laser beam shielding member according to any one of claims 1 to 4, wherein the adjustment of the shape of the line beam is adjustment of a length of the line beam in a long axis direction.

[Claim 6]

A laser processing device comprising:

a laser light source configured to output a laser beam;

an optical system configured to form the laser beam into a line beam shape and guide the laser beam to a body to be processed;

a processed body holding unit configured to hold the body to be processed in preparation for irradiation of the laser beam; and

the laser beam shielding member according to any one of claims 1 to 5,

wherein the laser beam shielding member is disposed so that a plurality of split line beams can be formed by shielding transmittance of part of the line beam on a light path leading to the body to be processed held by the processed body holding unit, with the laser beam formed in the line beam shape being guided.

[Claim 7]

The laser processing device according to claim 6, wherein the shielding member can slidingly move and/or rotatingly move.

[Claim 8]

The laser processing device according to claim 6 or 7, wherein the body to be processed has a laminated structure, and separation processing is performed on the body to be processed.

[Claim 9]

The laser processing device according to claim 6 or 7, wherein the body to be processed is a substrate having a semiconductor layer, and the semiconductor layer is crystalized or a crystal of the semiconductor layer is activated.

[Claim 10]

The laser processing device according to any one of claims 6 to 9, wherein the body to be processed is a plastic substrate.

[Claim 11]

A laser beam irradiation method comprising:

forming a laser beam into a line beam shape;

disposing a shielding member part or the whole of which can move on a light path of the line beam to shield transmittance of part of the line beam and form a plurality of split line beams having a shape determined according to a position where the shielding member is disposed through the movement; and

irradiating a body to be processed with the split line beams.

Claims

[Claim 1]

A laser beam shielding member shielding transmittance of full width of a short axis width of a laser beam in a line beam shape along a short axis direction in part of a long axis direction, and the laser beam is transmitted other than the shielding of full width of a short axis width within the range other than a long axis edge, to form a plurality of split line beams to be radiated on a body to be processed,

wherein the shielding member is provided so that a shielding shape extends by a length which exceeding a short axis width of the laser beam, and the width shape of the shielding member changes stepwise or continuously in the length direction, part or the whole of the shielding member can perform sliding movement relatively in the line beam shape in a short axis width direction of the laser beam in the length direction with respect to a light path of the laser beam, and the shielding shape shielding the laser beam changes in accordance with the movement, and adjustment of a shape of the split laser beams can be performed.

[Claim 2]

A laser beam shielding member shielding transmittance of full width of a short axis width of a laser beam in a line beam shape along a short axis direction in part of a long axis direction, and the laser beam is transmitted other than the shielding of full width of a short axis width, to form a plurality of split line beams to be radiated on a body to be processed,

wherein the shielding member is provided so that part or the whole of the shielding member can perform a rotational movement

relatively with respect to a light path of the laser beam in the line beam shape, and a shielding shape with respect to the laser beam changes in accordance with the movement, and adjustment of a shape of the split laser beams can be performed.

[Claim 3]

The laser beam shielding member according to claim 2, wherein the shielding member is provided so that a shielding shape extends by a length which exceeding a short axis width of the laser beam, and the width shape of the shielding member changes stepwise or continuously in the length direction, and part or the whole of the shielding member can perform a sliding movement relatively in a short axis width direction of the laser beam in the length direction with respect to a light path of the laser beam in the line beam shape, and the shielding shape with respect to the laser beam changes in accordance with the rotational movement and/or the sliding movement, and adjustment of a shape of the split laser beams can be performed.

[Claim 4]

The laser beam shielding member according to any one of claims 1 to 3, wherein the adjustment of the shape of the line beam is adjustment of a length of the line beam in a long axis direction.

[Claim 5]

A laser processing device comprising:

a laser light source configured to output a laser beam;

an optical system configured to form the laser beam into a line beam shape and guide the laser beam to a body to be processed;

a processed body holding unit configured to hold the body to be processed in preparation for irradiation of the laser beam; and

the laser beam shielding member according to any one of claims 1 to 4,

wherein the laser beam shielding member is disposed so that a plurality of split line beams can be formed by shielding transmittance of full width of a short axis width of a laser beam along a short axis direction in part of a long axis direction on a light path leading to the body to be processed held by the processed body holding unit, with the laser beam formed in the line beam shape being guided, and the laser beam is transmitted other than the shielding of full width of a short axis width within the range other than a long axis edge.

[Claim 6]

The laser processing device according to claim 5, wherein the body to be processed has a laminated structure, and separation processing is performed on the body to be processed.

[Claim 7]

The laser processing device according to claim 5 or 6, wherein the body to be processed is a substrate having a semiconductor layer, and the semiconductor layer is crystalized or a crystal of the semiconductor layer is activated.

[Claim 8]

The laser processing device according to any one of claims 5 to 7, wherein the body to be processed is a plastic substrate.