

particularly thin and easy to produce.

Summary

In an aspect, the present disclosure refers to an end effector for holding substrates, having a multi-layered main body and a fluid channel which is provided in the main body, wherein the main body comprises three layers, wherein each of the three layers is not inherently stable but has sufficient stability to hold the substrates when the three layers are fixed together.

In another aspect, the present disclosure refers to an end effector for holding substrates, having a multi-layered main body and a fluid channel which is provided in the main body, wherein the main body comprises at least two layers, wherein at least one of the layers is not inherently stable, wherein the fluid channel issues into openings, wherein a vacuum suction cup is provided in the openings, and wherein the main body comprises an upper layer, a middle layer and a lower layer, and the vacuum suction cup has a carrier that is passed through the middle layer and the upper layer and is held in position by the lower layer.

In an example, an end effector for holding substrates is provided, having a main body and a fluid channel which is provided in the main body, wherein the main body comprises at least two layers, wherein at least one of the layers is not inherently stable.

"Not inherently stable" means that the layer is not stable enough to independently hold a substrate, for which the corresponding end effector is provided, in the holding region provided for this purpose. The at least one layer can thus be thin, whereby the whole construction height, i.e. the thickness, of the end effector can be reduced. It is even feasible for a plurality of layers or all layers of the end effector not to be inherently stable and to have the necessary stability to hold a substrate only once fastened to one another. The layer which is not inherently stable can be e.g. a thin film, or the end effector can be built up of a plurality of very thin metal sheets. The fluid channel can thus serve as a vacuum channel or excess pressure channel depending on whether the end

effector is to be operated with a compressed air source or a vacuum source.

In the context of the invention, the term „layer“ refers to prefabricated layer, i.e. a prefabricated component in the solid state, in particular being flat and/or plate like. Two or more of the prefabricated components may be attached to one
5 another to form the end effector.

The prefabricated layer may already have the contour of the end effector or two or more layers are attached to one another and then cut into the desired shape of the end effector.

A coating or a liquid material applied to a prefabricated layer does not form a
10 layer of its own in the sense of the invention, even when solidified

The end effector can approach substrates both from below and also from above and hold or fix them from below or from above.

Preferably, a groove and/or a slot is incorporated in at least one of the layers and can partially define the fluid channel, whereby the fluid channel can easily be
15 formed.

In order to simplify the production process, the groove and/or the slot can be

covered and therefore sealed by at least another one of the layers.

In one example, the main body comprises three layers, wherein the middle one of the layers is provided with the slot and/or the groove, which is covered by the outer two layers, thus forming the fluid channel. Thus, at least one of the
5 outer two layers can be the layer which is not inherently stable. Therefore, a flatter or thinner end effector is provided.

For example, one of the layers, in particular the layer in which the groove and/or the slot is incorporated, is produced from a metal sheet. The metal sheet can be of high-grade steel or molybdenum. The metal sheet can also be
10 produced from titanium, aluminium with different coatings, or quartz glass. It is thereby ensured that the fluid channel always has the desired shape.

The at least two layers may be congruent to one another and/or may have the contour of the end effector. This saves an assembly step.

In a variant, at least one of the at least one layer is a prefabricated
15 component, simplifying the assembly.

One of the layers, in particular the layer which is not inherently stable, is preferably produced from a synthetic material, in particular a synthetic material film. The synthetic material is e.g. polyether ether ketone (PEEK). The layer of synthetic material is in particular the uppermost or lowermost layer of the main
20 body. Therefore, in particular, the layer which is not inherently stable can be produced inexpensively and consistently.

For example, a layer which is not inherently stable, produced from polyether ether ketone (PEEK) or a comparable synthetic material has a thickness of 0.1 mm or less.

25 In order to ensure the sealing tightness of the fluid channel, the at least two layers can be adhered together. Alternatively, the at least two layers can also be welded. In addition, the two layers can also be screwed, whereby the stability of the end effector is further increased.

In one example, the main body comprises a

receiving end and a fastening end, wherein a holding region for holding the substrate is provided on the receiving end so that the substrate can be reliably held on the the

end effector.

A cut-out preferably extends from the receiving end into the main body, wherein holding arms are formed by the cut-out. The cut-out can extend through all the layers. Therefore, substrates can be picked up by the end effector and
5 held on their underside approximately centrally e.g. by holding pins, e.g. at a station in a machine.

In order to improve the stability of the individual layers and of the whole main body, the cut-out can comprise at least one radius on its end facing the fastening end and in particular can be U-shaped.

10 In one example variant, the fluid channel extends from the fastening end into the holding region, in particular into the holding arms, and at that location issues into openings. Thus, the fluid channel can have a U-shaped portion. The negative pressure or excess pressure required to hold the substrate can be provided in the holding region through the fluid channel.

15 For example, the limbs of the U of the U-shaped portion of the fluid channel extend into the holding arms. The fluid channel can as a whole be Y-shaped or in the shape of a tuning fork.

At least one opening is preferably provided in one of the layers, in particular in one of the holding arms, through which opening the fluid channel issues in the
20 holding region. Thus, at least one opening can be provided per holding arm. The opening is provided in the uppermost layer. The side of the main body against which the substrate lies when the end effector is being used as intended is designated as 'upper' or as the 'upper side'.

In one example, a holding apparatus is provided in or at the opening and in
25 particular comprises a sealing lip, whereby the substrate can be fixed in a reliable manner.

For example, the holding apparatus is a suction apparatus, in particular a vacuum suction cup or a fixing apparatus based on the Bernoulli effect. In this way, substrates can be fixed on the end effector either by negative pressure or by
30 excess pressure.

The suction apparatus can comprise the sealing lip. The suction apparatus

Claims

1. End effector for holding substrates, having a multi-layered main body and a fluid channel which is provided in the main body, wherein the main body comprises
5 three layers, wherein each of the three layers is not inherently stable but has sufficient stability to hold the substrates when the three layers are fixed together.
2. End effector as claimed in claim 1, characterised in that a groove and/or a slot is incorporated in at least one of the layers and partially defines the fluid channel.
3. End effector as claimed in claim 2, characterised in that the groove and/or
10 the slot is covered and sealed by at least another one of the layers.
4. End effector as claimed in claim 3, characterised in that the middle layer of the three layers is provided with the slot which is covered by the outer two layers, thus forming the fluid channel.
5. End effector as claimed in any one of the preceding claims, characterised in
15 that the layer in which the groove and/or the slot is incorporated, is produced from a metal sheet.
6. End effector as claimed in any one of the preceding claims, characterised in that the three layers are congruent to one another and/or have the contour of the end effector.
7. End effector as claimed in any one of the preceding claims, characterised in
20 that at least one of the layers is a prefabricated component.
8. End effector as claimed in any one of the preceding claims, characterised in that the layers which are not inherently stable are produced from a synthetic material.
9. End effector as claimed in any one of the preceding claims, characterised in
25 that the three layers are adhered together.
10. End effector as claimed in any one of the preceding claims, characterised in that the main body comprises a receiving end and a fastening end, wherein a holding region for holding the substrate is provided on the receiving end.
11. End effector as claimed in claim 10, characterised in that a cut-out extends
30 from the receiving end into the main body, wherein holding arms are formed by the cut-out.

12. End effector as claimed in claim 11, characterised in that the cut-out comprises at least one radius on its end facing the fastening end and is U-shaped.

13. End effector as claimed in any one of claims 11 to 12, characterised in that the fluid channel extends from the fastening end into the holding arms and at that
5 location issues into openings.

14. End effector as claimed in claim 13, characterised in that a holding apparatus is provided in or on the opening.

15. End effector as claimed in claim 14, characterised in that the holding apparatus is a vacuum suction cup or a fixing apparatus based on the Bernoulli
10 effect.

16. End effector as claimed in any one of claims 10 to 15, characterised in that a flange region is provided on the fastening end in order to fasten the end effector to a transport apparatus.

17. End effector for holding substrates, having a multi-layered main body and a
15 fluid channel which is provided in the main body, wherein the main body comprises at least two layers, wherein at least one of the layers is not inherently stable, wherein the fluid channel issues into openings, wherein a vacuum suction cup is provided in the openings, and wherein the main body comprises an upper layer, a middle layer and a lower layer, and the vacuum suction cup has a carrier that is passed through
20 the middle layer and the upper layer and is held in position by the lower layer.