for strengthening the interfaces are therefore steps that promote the appearance of defects in the structure and even delamination of a substrate.

~~The~~Embodiments of the present invention ~~aims~~seek to overcome all or some of the aforementioned drawbacks~~, and relates to~~

According to an aspect of the present invention, there is provided a process for transferring a layer, comprising the following steps:

(a) providing a donor substrate and a support substrate made of materials having a first and second thermal expansion coefficient, respectively;

(b) forming a embrittlement region in the donor substrate so as to delimit a first part and a second part in the donor substrate on either side of the embrittlement region, the first part being intended to form the layer to be transferred to the support substrate;

(c) forming what is called a bonding layer between the first part of the donor substrate and the support substrate, the bonding layer having a preset thickness; and

(d) assembling the donor substrate to the support substrate, the transfer process being noteworthy in that it comprises the following step:

(e) exposing, in succession, portions of the embrittlement region to electromagnetic irradiations for an exposure time at a given power density, the electromagnetic irradiations belonging to a spectral domain chosen so that the support substrate, the bonding layer and the donor substrate are transparent, transparent and absorbent, respectively, in said spectral domain, the exposure time being chosen depending on the thickness of the bonding layer so that the temperature of the support substrate remains below a threshold during the exposure time, above which threshold defects are liable to appear in the structure comprising the support substrate, the bonding layer and the donor substrate, the exposure time being chosen depending on the power density in order to activate kinetics that weaken the embrittlement region.

Such a transfer process, according to embodiments of the invention, thus allows a localized heat treatment to be applied by exposing, in succession, portions of the embrittlement region to electromagnetic irradiations. Therefore, the electromagnetic irradiations propagate, in the support substrate and the

CLAIMS

1. Process for transferring a layer ~~(1)~~ comprising the following steps:
(a) providing a donor substrate ~~(2)~~ and a support substrate ~~(3)~~ made of materials having a first and second thermal expansion coefficient, respectively;
(b) forming a embrittlement region ~~(4)~~ in the donor substrate ~~(2)~~ so as to delimit a first part ~~(1)~~ and a second part ~~(20)~~ in the donor substrate ~~(2)~~ on either side of the embrittlement region ~~(4)~~, the first part ~~(1)~~ being intended to form the layer ~~(1)~~ to be transferred to the support substrate;
(c) forming what is called a bonding layer ~~(5)~~ between the first part ~~(1)~~ of the donor substrate ~~(2)~~ and the support substrate ~~(3)~~, the bonding layer ~~(5)~~ having a preset thickness; and
(d) assembling the donor substrate ~~(2)~~ to the support substrate ~~(3)~~, the transfer process ~~being characterized in that it comprises~~ further comprising the following step:
(e) exposing, in succession, portions ~~(40)~~ of the embrittlement region ~~(4)~~ to electromagnetic irradiations ~~(6)~~ for an exposure time at a given power density, the electromagnetic irradiations ~~(6)~~ belonging to a spectral domain chosen so that the support substrate ~~(3)~~, the bonding layer ~~(5)~~ and the donor substrate ~~(2)~~ are transparent, transparent and absorbent, respectively, in said spectral domain, the exposure time being chosen depending on the thickness ~~(E)~~ of the bonding layer ~~(5)~~ so that the temperature of the support substrate ~~(3)~~ remains below a threshold ~~(T0)~~ during the exposure time, above which threshold defects are liable to appear in the structure comprising the support substrate ~~(3)~~, the bonding layer ~~(5)~~ and the donor substrate ~~(2)~~, the exposure time being chosen depending on the power density in order to activate kinetics that weaken the embrittlement region ~~(4)~~.

2. Transfer process according to Claim 1, ~~characterized in that~~wherein the exposure time is chosen depending on the thickness ~~(E)~~ of the bonding layer ~~(5)~~ so that the thermal diffusion length in the bonding layer ~~(5)~~ is smaller than or equal to the thickness ~~(E)~~ of the bonding layer ~~(5)~~.

3. Transfer process according to either of Claims 1 and 2, ~~characterized in that~~ wherein the electromagnetic irradiations ~~(6)~~ are electromagnetic pulses, and in that the length of each electromagnetic pulse respects the following relationship: $e \geq \sqrt{2D\tau}$; where D is the thermal diffusion coefficient of the bonding layer, τ is the length of one electromagnetic pulse, and e is the thickness of the bonding layer, τ preferably being between 0 ns and 10 µs, and e preferably being lower than 10 µm.

4. Transfer process according to one of Claims 1 to 3, ~~characterized in that~~ wherein step (e) is executed using at least one laser emitting the electromagnetic irradiations, said laser being moved so as to expose, in succession, the portions ~~(40)~~ of the embrittlement region ~~(4)~~.

5. Transfer process according to one of Claims 1 to 4, ~~characterized in that~~ wherein the donor substrate ~~(2)~~ has a thermal conductivity, and in that the bonding layer ~~(5)~~ has a thermal conductivity that is lower than the thermal conductivity of the donor substrate ~~(2)~~, the thermal conductivity of the bonding layer ~~(5)~~ preferably respecting the following relationship: $\sigma_{CL} \leq \frac{1}{10}\sigma_{SD}$; where σ_{CL} is the thermal conductivity of the bonding layer ~~(5)~~ and σ_{SD} is the thermal conductivity of the donor substrate ~~(2)~~.

6. Transfer process according to one of Claims 1 to 5, ~~characterized in that~~ wherein step (d) is executed at a temperature below a threshold above which defects are liable to appear in the structure comprising the support substrate ~~(3)~~, the bonding layer ~~(5)~~ and the donor substrate ~~(2)~~, said temperature preferably being below 300°C and even more preferably below 200°C.

7. Transfer process according to Claim 6, characterized in that the temperature at which step (d) is executed is chosen so that the support substrate ~~(3)~~ and the bonding layer ~~(5)~~ exhibit an interface ~~(50)~~ having a

bonding energy such that they are reversibly assembled, said temperature preferably being below 250°C and even more preferably below 150°C.

8. Transfer process according to Claim 7, ~~characterized in that~~wherein it comprises the following steps:

- detaching the support substrate ~~(3)~~ from the bonding layer ~~(5)~~ after step (e);
- providing what is called a final support substrate;
- assembling the donor substrate ~~(2)~~ to the final support substrate by way of the bonding layer ~~(5)~~; and
- fracturing the donor substrate ~~(2)~~ in the embrittlement region ~~(4)~~.

9. Transfer process according to one of Claims 1 to 7, ~~characterized in that~~ wherein the exposure time is chosen depending on the power density in order to fracture the donor substrate ~~(2)~~ in the embrittlement region ~~(4)~~.

10. Transfer process according to one of Claims 1 to 9, ~~characterized in that~~ wherein the material from which the donor substrate ~~(2)~~ is made is a semiconductor, preferably selected from the group comprising silicon, germanium, silicon-germanium, and III-V materials such as gallium nitride, gallium arsenide and indium phosphide.

11. Transfer process according to one of Claims 1 to 10, ~~characterized in that~~ wherein the material from which the support substrate ~~(3)~~ is made is selected from the group comprising silicon, quartz, silica, sapphire, diamond, and glass.

12. Transfer process according to one of Claims 1 to 11, ~~characterized in that~~ wherein the bonding layer ~~(5)~~ is a dielectric layer, preferably made from silicon dioxide or a nitride.

13. Transfer process according to one of Claims 1 to 12, ~~characterized in that~~ wherein the embrittlement region ~~(4)~~ is formed in step (b) by implanting species such as hydrogen and/or helium.