monocrystalline being at the interface with the support substrate and the amorphous portion being at the surface of the structure obtained after the transfer step,

- recrystallizing the amorphous portion of the transferred monocrystalline layer, the crystal lattice of the underlying portion that has remained monocrystalline serving as a seed for recrystallization, said recrystallization being carried out at a temperature of between 550 and 600°C.

This recrystallization step of the amorphous portion is known in the art under the name of Solid Phase Epitaxy (SPE).

The recrystallization has the effect of activating the dopants contained in the amorphous portion.

However, in this method, the species that are implanted into the monocrystalline layer to form the embrittlement zone go through the portion that has been kept monocrystalline during the amorphisation step.

As a consequence, said monocrystalline portion is damaged by the implanted species and, in particular, the dopants that it may contain are deactivated.

Since this portion is not amorphous but monocrystalline, the damages will not be healed by the recrystallization step, and the dopants will not be reactivated in this portion, unless a heat treatment is carried out at a high temperature.

~~One goal~~Embodiments of the invention ~~is thus~~seek to ~~define~~provide a method for transferring a monocrystalline semiconductor layer onto a support substrate following which the transferred layer no longer contains the crystalline defects possibly generated by the embrittlement implantation.

In particular, ~~one goal~~embodiments of the invention ~~is~~seek to restore to a transferred layer comprising a doped region its initial electrical properties, in spite of the dopant deactivation generated by the embrittlement implantation.

Besides, said method should be able to be implemented entirely at moderate temperatures, *i.e.*, not exceeding roughly 500 °C.

BRIEF DESCRIPTION OF THE INVENTION

According to an aspect of the present invention, there is provided a method for transferring a monocrystalline semiconductor layer onto a support substrate, which comprises: implanting species through a surface of a donor substrate that includes

monocrystalline semiconductor material to form therein an embrittlement zone delimiting a layer to be transferred, with the layer to be transferred comprising first and second portions, the first portion including a surface portion and the second portion including a buried portion; bonding the donor substrate to a support substrate; fracturing the donor substrate at the embrittlement zone to transfer the layer onto the support substrate; removing a surface portion of the transferred layer, so that part of the first portion of the transferred layer after the removal of the surface portion remains on the support substrate; treating the layer to obtain amorphisation of the first portion without disorganizing the crystal lattice of the second portion, and recrystallizing the amorphized first portion of the transferred layer at a temperature that is below 500 °C to provide a crystal lattice therein, wherein the recrystallizing is carried out after the implanting of species through the surface of the donor substrate.

~~In accordance with the invention~~As disclosed herein, a method ~~is proposed~~ for transferring a monocrystalline semiconductor layer onto a support substrate ~~comprising~~comprises the following successive steps:

(a) implanting species in a substrate, referred to as the donor substrate, so as to form in the donor substrate an embrittlement zone delimiting the monocrystalline layer to be transferred;

(b) bonding the donor substrate to said support substrate;

(c) fracturing the donor substrate at the embrittlement zone, so as to transfer the layer onto the support substrate;

(d) removing a surface portion of the transferred monocrystalline layer.

Said method is remarkable in that it further comprises steps wherein:

- a first portion of the monocrystalline layer to be transferred is rendered amorphous, without disorganizing the crystal lattice of a second portion of the monocrystalline layer, said first and second portions being, respectively, a surface portion and a buried portion of the monocrystalline layer relative to the direction of implantation, the thickness of said first portion being greater than the thickness of the transferred monocrystalline layer after the removal of its surface portion carried out at step (d);
- said first amorphous portion of the monocrystalline layer is recrystallized, the crystal lattice of said second portion serving as a seed for recrystallization, said recrystallization being carried out at a temperature below 500 °C.

According to ~~a first~~an embodiment ~~of the inventive method~~, amorphization of said first portion of the monocrystalline layer is implemented before the implantation step (a).

According to ~~a second~~an embodiment of the invention, amorphization of said first portion of the monocrystalline layer is implemented after the implantation step (a).

According to a particular embodiment, the amorphization of said first portion of the monocrystalline layer is implemented after the transfer step (c).

In a preferred manner, said amorphization comprises the implantation, in said first portion, of atomic species whose atomic number is greater than or equal to that of the semiconductor material of the monocrystalline layer.

According to a particular embodiment of the invention, the semiconductor material of the monocrystalline layer is silicon and the species implanted for amorphization of the first portion are selected among silicon, germanium, xenon and/or argon.

For example, the implanted species is silicon and the implanted dose is greater than or equal to $5\times10^{12}/cm^2$.

In a particularly advantageous manner, recrystallization of the first portion of the transferred layer is carried out by solid-phase epitaxy (SPE).

Furthermore, the donor substrate can advantageously be bonded to the support substrate via a bonding layer whose material is selected from metals, silicides and group III-V semiconductors, said bonding layer being deposited on the donor substrate