To overcome this drawback, it is known practice to form a layer for trapping metal atoms within the SOI substrate.

Document US 6,083,324 thus describes the formation of a trapping layer in the active layer of the SOI substrate by ion-implanting gaseous species and then carrying out a heat treatment suitable for forming, from the implanted ions, microbubbles or precipitates. These microbubbles or precipitates form trap sites for metal atoms. However, this trapping layer, due to the cavities and interfaces that it forms in the pixel, may interfere with the trajectory of photons through the pixels and negatively affect the electrical performance of the image sensor.

Document US 2010/0090303 describes the formation of a trapping layer in the carrier substrate. More specifically, when the SOI substrate is formed using a Smart Cut™ layer transfer technique, the process for fabricating the SOI substrate comprises the following steps:

- providing a silicon donor substrate covered with a layer of silicon oxide that is intended to form the BOX and comprising a weakened zone delimiting a thin layer of silicon;
- providing a carrier substrate in which the trapping layer has been formed by ion implantation;
- bonding the donor substrate and the carrier substrate via the oxide layer;
- detaching the donor substrate along the weakened zone in order to transfer the thin layer of silicon and the oxide layer to the carrier substrate;
- epitaxially growing an additional layer of silicon on top of the transferred thin layer until the desired thickness for the active layer of the image sensor has been obtained.

However, the surface state of the carrier substrate that has undergone ion implantation for the purpose of forming the trapping layer is of insufficient quality to provide a good bonding hold if the buried oxide layer is very thin, which is a notable drawback of this process in particular in the context of bonding thin oxides such as those targeted for a near-infrared front-side image sensor.

SUMMARY OF THE INVENTION

There is therefore still a need to form a trapping zone in the carrier substrate of a semiconductor-on-insulator structure for forming a front-side image sensor while guaranteeing good adhesion between the active layer and the carrier substrate.

An aspect of the present invention provides a process for fabricating a substrate for a front-side image sensor, comprising:

providing a donor substrate comprising a semiconductor layer to be transferred;

providing a semiconductor carrier substrate;

bonding the donor substrate to the carrier substrate, an electrically insulating layer being at the bonding interface;

transferring the semiconductor layer to the carrier substrate;

implanting gaseous ions into the carrier substrate through the transferred semiconductor layer and the electrically insulating layer;

after said implantation, epitaxially growing an additional semiconductor layer on top of the transferred semiconductor layer.

Advantageously, said process comprises a heat treatment carried out at a temperature suitable for causing cavities to develop from the implanted gaseous ions, said cavities forming a layer for trapping metal atoms in the carrier substrate.

According to one embodiment, said heat treatment is carried out during the epitaxial growth of the additional semiconductor layer.

Preferably, the density of cavities in the trapping layer is higher than or equal to 10^{15} cavities/cm^3.

According to one embodiment, each semiconductor layer is a silicon layer.

According to one embodiment, the electrically insulating layer is a silicon oxide layer.

Alternatively, the electrically insulating layer consists of a stack of dielectric and/or metal materials.

Preferably, the thickness of the electrically insulating layer is between 5 nm and 400 nm, and preferably between 30 nm and 150 nm.

Preferably, the gaseous ions comprise helium ions.

According to one embodiment, the transfer of the semiconductor layer comprises:

- forming a weakened zone in the donor substrate in order to define said semiconductor layer to be transferred;

- after bonding, the donor substrate is detached along the weakened zone.

There is also disclosed a process for fabricating a front-side image sensor, comprising the fabrication of a substrate using the process as described above, the transferred semiconductor layer and the additional semiconductor layer together forming an active layer of said image sensor, and the formation, in said active layer, of a plurality of electrically isolating trenches in order to define a plurality of pixels.

BRIEF DESCRIPTION OF THE FIGURES

Other features and advantages of the invention will emerge from the detailed description which follows, with reference to the appended drawings in which:

- Figure 1A is a sectional view of an SOI substrate for an image sensor according to one embodiment of the invention;

- Figure 1B is a sectional view of a substrate according to one variant of Figure 1A;

- Figure 2 schematically illustrates the implantation of atomic species into a donor substrate in order to form a weakened zone there delimiting a semiconductor layer to be transferred;

CLAIMS

1. A process for fabricating a substrate for a front-side image sensor, comprising:

- providing a donor substrate comprising a semiconductor layer to be transferred;
- providing a semiconductor carrier substrate;
- bonding the donor substrate to the carrier substrate, an electrically insulating layer being at the bonding interface;
- transferring the semiconductor layer to the carrier substrate;
- implanting gaseous ions into the carrier substrate through the transferred semiconductor layer and the electrically insulating layer;
- after said implantation, epitaxially growing an additional semiconductor layer on top of the transferred semiconductor layer.

2. Process according to Claim 1, comprising a heat treatment carried out at a temperature suitable for causing cavities to develop from the implanted gaseous ions, said cavities forming a layer for trapping metal atoms in the carrier substrate.

3. Process according to Claim 2, wherein said heat treatment is carried out during the epitaxial growth of the additional semiconductor layer.

4. Process according to either of Claims 2 and 3, wherein the density of cavities in the trapping layer is higher than or equal to 10^{15} cavities/cm^3.

5. Process according to one of Claims 1 to 4, wherein each semiconductor layer is a silicon layer.

6. Process according to one of Claims 1 to 5, wherein the electrically insulating layer is a silicon oxide layer.

7. Process according to one of Claims 1 to 6, wherein the electrically insulating layer consists of a stack of dielectric and/or metal materials.

8. Process according to one of Claims 1 to 7, wherein the thickness of the electrically insulating layer is between 5 nm and 400 nm, and preferably between 30 nm and 150 nm.

9. Process according to one of Claims 1 to 8, wherein the gaseous ions comprise helium ions.

10. Process according to one of Claims 1 to 9, wherein the transfer of the semiconductor layer comprises:

- forming a weakened zone in the donor substrate in order to define said semiconductor layer to be transferred;

- after bonding, detaching the donor substrate along the weakened zone.

11. Process for fabricating a front-side image sensor, comprising the fabrication of a substrate using the process according to one of Claims 1 to 10, the transferred semiconductor layer and the additional semiconductor layer together forming an active layer of said image sensor, and the formation, in said active layer, of a plurality of electrically isolating trenches in order to define a plurality of pixels.