OBJECT OF THE INVENTION

The present invention seeks to provide an alternative to the prior-art solutions, aiming to overcome all or some of the aforementioned drawbacks. It relates to a process for fabricating a composite structure comprising a working layer made of single-crystal SiC transferred to a carrier substrate made of polycrystalline SiC; the invention also relates to said carrier substrate and to the obtained composite structure.

BRIEF DESCRIPTION OF THE INVENTION

An aspect of the invention provides a process for fabricating a composite structure comprising a working layer made of single-crystal silicon carbide placed on a carrier substrate made of polycrystalline silicon carbide, the process comprising:

a) a step of providing an initial substrate made of polycrystalline silicon carbide, having a front side and comprising grains the average size of which, in the plane of said front side, is larger than 0.5 μm;

b) a step of forming a surface layer made of polycrystalline silicon carbide on the initial substrate, in order to form the carrier substrate, the surface layer being made up of grains the average size of which is smaller than 500 nm, and having a thickness comprised between 50 nm and 50 μm;

c) a step of preparing a free surface of the surface layer of the carrier substrate, in order to obtain a roughness lower than 1 nm RMS;

d) a step, based on molecular bonding, of transferring the working layer to the carrier substrate, the surface layer being positioned between the working layer and the initial substrate.

d3) joining the front side of the donor substrate to the carrier substrate, by molecular bonding;

d4) separating along the buried weak plane, leading to the transfer of the working layer to the carrier substrate;

- the fabricating process comprises forming a second surface layer, of the same nature as the surface layer, on the front side of the donor substrate, before or after the phase d2);
- step d) comprises, before the joining phase d3), depositing an additional film made of a metal or of silicon on the surface layer of the carrier substrate and/or on the front side of the donor substrate.

Another aspect of the invention provides a carrier substrate made of polycrystalline silicon carbide, comprising:
- an initial substrate comprising silicon-carbide grains, said grains having an average size larger than 0.5 μm,
- a surface layer placed at least on a front side of the initial substrate, comprising silicon-carbide grains the average size of which is smaller than 500 nm, and having a thickness comprised between 50 nm and 50 μm.

According to other advantageous and non-limiting features of the invention, which are applicable individually or in any technically feasible combination:

- a free surface of the surface layer has a roughness lower than 1 nm RMS and less than 1 defect/cm^2, as measured by reflected dark-field microscopy, with a threshold of 0.5 μm;
- the thickness of the surface layer is comprised between 200 nm and 5 μm;
- the surface layer has a dopant concentration comprised between 1E18/cm^3 and 1E21/cm^3.

Another aspect of the invention provides a composite structure comprising:

- the carrier substrate such as mentioned above,
- a working layer made of single-crystal silicon carbide placed on the surface layer.

The composite structure may further comprise at least one power device on or in the working layer.

BRIEF DESCRIPTION OF THE FIGURES

Other features and advantages of the invention will become apparent on reading the following detailed description of the invention, with reference to the appended figures, in which:

[Fig. 1] Figure 1 shows a composite structure produced using a fabricating process according to the invention;

[Fig. 2a]
[Fig. 2b]
[Fig. 2c]
[Fig. 2d] Figures 2a to 2d show steps of a fabricating process according to the invention;

[Fig. 3a]
[Fig. 3b]
[Fig. 3c]
[Fig. 3d] Figures 3a to 3d show steps of one preferred embodiment of the fabricating process according to the invention.

The same references in the figures may be used for elements of the same type. The figures are schematic representations that, for the sake of readability, have not been drawn to scale. In