Irrespective of the layer transfer technique employed, a further problem arising is that of providing a composite structure comprising a thin c-SiC layer of very high quality, and more particularly devoid of extended defects (or having a very low density of such defects), which are liable to adversely affect the performance and the reliability of the power devices that are to be produced on said thin layer.

SUBJECT OF THE INVENTION

The present invention relates to an alternative solution to those of the prior art, and aims wholly or partly to overcome the aforementioned drawbacks. It relates more particularly to a process for producing a composite structure comprising a thin c-SiC layer of high quality arranged on a crystalline SiC carrier substrate.

BRIEF DESCRIPTION OF THE INVENTION

An aspect of the invention relates to a process for producing a composite structure comprising a thin layer of monocrystalline silicon carbide arranged on a carrier substrate of silicon carbide. The process comprises:

a) a step of provision of an initial substrate of monocrystalline silicon carbide,

b) a step of epitaxial growth of a donor layer of monocrystalline silicon carbide on the initial substrate, carried out at a temperature greater than 1200°C, preferably of between 1500°C and 1650°C, to form a donor substrate, the donor layer having a lower crystal defect density than the initial substrate,

c) a step of ion implantation of light species into the donor layer, to form a buried brittle plane delimiting the thin

CLAIMS

1. Process for producing a composite structure ~~(1)~~ comprising a thin layer ~~(10)~~ of monocrystalline silicon carbide arranged on a carrier substrate ~~(20)~~ of silicon carbide, the process comprising:

a) a step of provision of an initial substrate ~~(11)~~ of monocrystalline silicon carbide,

b) a step of epitaxial growth of a donor layer ~~(110)~~ of monocrystalline silicon carbide on the initial substrate ~~(11)~~, carried out at a temperature greater than 1200°C, preferably of between 1500°C and 1650°C, to form a donor substrate ~~(111)~~, the donor layer ~~(110)~~ having a lower crystal defect density than the initial substrate ~~(11)~~,

c) a step of ion implantation of light species into the donor layer ~~(110)~~, to form a buried brittle plane ~~(12)~~ delimiting the thin layer ~~(10)~~ between said buried brittle plane ~~(12)~~ and a free surface of said donor layer ~~(110)~~,

d) a step of formation of a carrier substrate ~~(20)~~ of silicon carbide on the free surface of the donor layer ~~(110)~~, comprising a deposition at a temperature of between 400°C and 1100°C, and defining a non-insulating interface between the donor layer ~~(110)~~ and the carrier substrate ~~(20)~~,

e) a step of separation along the buried brittle plane ~~(12)~~, to form the composite structure ~~(1)~~ on the one hand and the remnant ~~(111')~~ of the donor substrate on the other hand,

f) a step of mechanical and/or chemical treatment(s) of the composite structure ~~(1)~~, to smooth the free surface of the thin layer ~~(10)~~ and to correct the thickness uniformity of the composite structure ~~(1)~~.

2. Production process according to the preceding claim, wherein the deposition of step d) is carried out at a temperature of between 600°C and 900°C, and even, preferably, between

700°C and 800°C, and is based on a chemical vapour deposition technique or a sintering technique or a liquid-phase deposition technique using a solution of ceramic powder.

3. Production process according to the preceding claim, wherein the deposition of step d) is a chemical vapour deposition assisted by direct liquid injection.

4. Production process according to Claim 2, wherein the deposition of step d) is a plasma-enhanced or low-pressure chemical vapour deposition.

5. Production process according to any of the preceding claims, wherein the deposition of step d) is carried out at a rate of greater than 10 microns/hour, and even, preferably, greater than 50 microns/hour.

6. Production process according to any of the preceding claims, wherein, at the end of the deposition of step d), the carrier substrate ~~(20)~~ has a thickness of greater than or equal to 50 microns, and even a thickness of greater than or equal to 100 microns.

7. Production process according to any of the preceding claims, wherein step a) comprises the formation, on the initial substrate ~~(11)~~, of a monocrystalline conversion layer ~~(13)~~, for converting the basal plane dislocation defects of the initial substrate ~~(11)~~ into threading edge dislocation defects.

8. Production process according to any of the preceding claims, wherein the separation step e) is operated at a temperature

greater than or equal to the temperature of the deposition of step d).

9. Production process according to any of the preceding claims, wherein step f) comprises simultaneous chemical-mechanical polishing of a front face and a back face of the composite structure ~~(1)~~.

10. Production process according to any of the preceding claims, comprising a step of heat treatment at a temperature of between 1000°C and 1800°C, before or after step f).

11. Production process according to any of the preceding claims, comprising a step of reconditioning of the remnant ~~(111')~~ of the donor substrate with a view to reusing it as initial substrate or as donor substrate.