CLAIMS:

1. A chemical vapour deposition system, including:

a process tube for receiving at least one sample, the process tube being constructed of silicon carbide, impregnated with silicon, and coated with silicon carbide;

a pumping system to evacuate the process tube to high vacuum;

one or more gas inlets for introducing one or more process gases into the evacuated process tube; and

a heater to heat the process tube and thereby heat the one or more process gases and the at least one sample within the process tube to cause a material to be deposited onto the at least one sample within the process tube by chemical vapour deposition.

2. The system of claim 1, wherein the high vacuum is in the 10^{-6} mBar range or lower.

3. The system of claim 1 or 2, wherein the system is capable of operating at temperatures up to about 1350°C.

4. The system of any one of claims 1 to 3, wherein the heater is circumferentially disposed about a central portion of the process tube disposed between outer portions of the process tube extending from the heater, and the system includes means for cooling the outer portions of the process tube.

5. The system of claim 3, wherein the means for cooling the outer portions of the process tube includes at least one heat sink.

6. The system of any one of claims 1 to 5, including two sets of radiation baffles disposed within the process tube and being mutually spaced about a flat zone of substantially constant temperature within the process tube, the radiation baffles being configured to reduce radiant heat loss from the flat zone.

7. The system of claim 6, wherein at least inner ones of the radiation baffles are composed of silicon carbide and coated with silicon carbide.

8. The system of claim 6 or 7, wherein the radiation baffles occupy respective regions within the process tube, and the one or more gas inlets are configured to deliver the gas into respective ones of those regions.

9. The system of any one of claims 1 to 8, wherein the one or more gas inlets include at least two gas inlets.

10. The system of any one of claims 1 to 9, including a silicon carbide liner disposed within the process tube.

11. The system of any one of claims 1 to 10, wherein all components of the system disposed within a flat zone of substantially constant temperature within the process tube during deposition are composed of silicon carbide coated with CVD silicon carbide.

12. The system of any one of claims 1 to 11, wherein the pumping system is configured to evacuate the process tube from only one end, using one turbo molecular pump.

13. The system of any one of claims 1 to 11, wherein the pumping system includes two turbo molecular pumps configured to pump from respective ends of the process tube.

14. The system of claim 13, wherein the one or more gas inlets include two gas inlets configured to introduce the one or more process gases into a flat zone of substantially constant temperature within the process tube from respective ends of the flat zone, and the system is configured to deposit the material in successive layers by alternating use of the pumps and gas inlets so that the process gas flows

in opposite directions through the flat zone during deposition of successive layers, thereby improving wafer to wafer uniformity of the deposited material.

15. The system of claim 13, wherein the one or more gas inlets include two gas inlets configured to introduce the one or more process gases into a flat zone of substantially constant temperature within the process tube from respective ends of the flat zone, and the system is configured to deposit the material by simultaneous use of the pumps and gas inlets so that the process gas flows in opposite directions through the flat zone during deposition, thereby improving wafer to wafer uniformity of the deposited material.

16. The system of any one of claims 1 to 15, wherein the one or more gas inlets include two gas inlets disposed at respective ends of the heated zone.

17. The system of any one of claims 1 to 16, including a gas storage reservoir configured to temporarily store a quantity of process gas and to subsequently release the stored process gas so as to rapidly increase the pressure within the process tube.

18. The system of any one of claims 1 to 17, wherein the system is configured to use the process gases undiluted in the process tube during deposition.

19. The system of any one of claims 1 to 18, including point of use purifiers to reduce contamination levels of the process gases to ppb levels.

20. The system of any one of claims 1 to 19, including a wafer holder configured to support one or more pairs of wafers in a closely spaced back to back vertical arrangement during deposition, the close spacing between the back surfaces of each pair of wafers being sufficiently small to reduce the deposition thickness on the back surfaces and sufficient large to facilitate evacuation of the process tube.

21. The system of any one of claims 1 to 20, including one or more wafer holders with sets of mutually spaced v-grooves for supporting wafers in a closely spaced back to back vertical arrangement during deposition, wherein the sets of v-grooves have respective different spacings between adjacent v-grooves to enable selection of a desired wafer spacing to provide a corresponding deposition thickness on the back surfaces of the wafers and thereby to provide a corresponding stress asymmetry between the opposite faces of each wafer.

22. The system of any one of claims 1 to 21, wherein the system is configured to deposit successive layers of a semiconductor with respective opposite doping polarities whilst maintaining the at least one sample within the process tube and under vacuum.

23. The system of any one of claims 1 to 22, wherein gas flow in the system is controlled by mass flow controllers via multiple gas manifolds and multiple bypass pumping arrangements to enable each of a plurality of process gas flows to independently stabilise while bypassing the process tube, before switching the stabilised process gas flow into the process tube.

24. The system of any one of claims 1 to 23, wherein the material is silicon carbide.

25. The system of claim 24, wherein the material is silicon carbide and the at least one sample is at least one single-crystal silicon wafer, the silicon carbide being device quality single-crystal silicon carbide deposited epitaxially on the at least one single-crystal silicon wafer.

26. A chemical vapour deposition process, including:

placing a sample in a process tube constructed of silicon carbide, impregnated with silicon, and coated with silicon carbide;

evacuating the process tube to high vacuum;

heating the process tube and thereby heating the at least one sample within the process tube; and

introducing one or more process gases into the evacuated and heated process tube to cause a material to be deposited onto the heated at least one sample within the process tube by chemical vapour deposition.

27. The process of claim 26, wherein the high vacuum is in the 10^{-6} mBar range or lower.

28. The process of claim 26 or 27, wherein during deposition the process tube is simultaneously pumped from respective ends, and the one or more process gases are simultaneously introduced into a flat zone of substantially constant temperature within the process tube from respective ends of the flat zone to improve the wafer to wafer uniformity of the deposited material.

29. The process of claim 26 or 27, wherein the material is deposited on the at least one sample in a flat zone of substantially constant temperature within the process tube, and the material is deposited as one or more pairs of successive layers of the material, wherein the net gas flows through the flat zone during deposition of successive layers of each pair are in opposite directions to improve the wafer to wafer uniformity of the deposited material.

30. The process of any one of claims 26 to 29, including releasing a quantity of stored process gas into the process tube to rapidly increase pressure within the process tube.

31. The process of any one of claims 26 to 30, wherein the one or more process gases are used undiluted in the process tube during deposition.

32. The process of any one of claims 26 to 31, wherein the at least one sample includes a plurality of wafers, and the process includes supporting the wafers in a closely spaced back to back vertical arrangement during deposition, the close spacing between the back surfaces of each pair of wafers being sufficiently small to reduce the deposition thickness on the back surfaces of the wafers and sufficiently large to facilitate evacuation of the process tube.

33. The process of any one of claims 26 to 31, wherein the at least one sample includes a plurality of wafers, and the process includes supporting the wafers in a mutually spaced arrangement during deposition so that the material is deposited substantially equally on both sides of each wafer to provide substantially equal stress thereon.

34. The process of any one of claims 26 to 33, including depositing successive layers of a semiconductor with respective opposite doping polarities whilst maintaining the at least one sample within the process tube and under vacuum.

35. The process of any one of claims 26 to 34, wherein the material is silicon carbide.

36. The process of any one of claims 26 to 35, wherein the at least one sample includes at least one single-crystal silicon wafer, and the material is device quality single-crystal silicon carbide deposited epitaxially on the at least one single-crystal silicon wafer.

37. A chemical vapour deposition system having components configured for performing the process of any one of claims 26 to 36.

CLAIMS:

1. A chemical vapour deposition system, including:

a process tube configured to receive at least one sample for deposition of a material thereon;

a pumping system to evacuate the process tube;

one or more gas inlets for introducing one or more process gases into the evacuated process tube; and

a heater to heat the process tube and thereby heat the one or more process gases and the at least one sample within the process tube to cause a material to be deposited onto the at least one sample within the process tube by chemical vapour deposition;

wherein the pumping system is configured to evacuate the process tube from respective ends thereof, the process tube is constructed of silicon carbide, impregnated with silicon, and coated with silicon carbide so as to have a vacuum integrity such that, in combination with the pumping speed of the pumping system, and the pumping conductance and vacuum integrity of the system, the process tube is evacuated to a high vacuum base pressure in the 10^{-6} mBar range or lower.

2. The system of claim 1, wherein the pumping system includes turbo molecular pumps configured to evacuate the process tube from respective ends thereof.

3. The system of claim 1 or 2, wherein the system is capable of operating at temperatures up to about 1350°C.

4. The system of any one of claims 1 to 3, wherein the heater is circumferentially disposed about a central portion of the process tube disposed between outer portions of the process tube extending from the heater, and the system includes means for cooling the outer portions of the process tube.

5. The system of claim 4, wherein the means for cooling the outer portions of the process tube includes at least one heat sink.

6. The system of any one of claims 1 to 5, including two sets of radiation baffles disposed within the process tube and being mutually spaced about a flat zone of substantially constant temperature within the process tube, the radiation baffles being configured to reduce radiant heat loss from the flat zone.

7. The system of claim 6, wherein at least inner ones of the radiation baffles are composed of silicon carbide and coated with silicon carbide.

8. The system of claim 6 or 7, wherein the radiation baffles occupy respective regions within the process tube, and the one or more gas inlets are configured to deliver the gas into respective ones of those regions.

9. The system of any one of claims 1 to 8, wherein the one or more gas inlets include at least two gas inlets.

10. The system of any one of claims 1 to 9, including a silicon carbide liner disposed within the process tube.

11. The system of any one of claims 1 to 10, wherein all components of the system disposed within a flat zone of substantially constant temperature within the process tube during deposition are composed of silicon carbide coated with CVD silicon carbide.

12. The system of any one of claims 1 to 11, wherein the one or more gas inlets include two gas inlets configured to introduce the one or more process gases into a flat zone of substantially constant temperature within the process tube from respective ends of the flat zone, and the system is configured to deposit the material in successive layers by alternating use of the pumps and gas inlets so that the process gas flows in opposite directions through the flat zone during deposition of successive layers, thereby improving wafer to wafer uniformity of the deposited material.

13. The system of any one of claims 1 to 11, wherein the one or more gas inlets include two gas inlets configured to introduce the one or more process gases into a flat zone of

substantially constant temperature within the process tube from respective ends of the flat zone, and the system is configured to deposit the material by simultaneous use of the pumps and gas inlets so that the process gas flows in opposite directions through the flat zone during deposition, thereby improving wafer to wafer uniformity of the deposited material.

14. The system of any one of claims 1 to 13, wherein the one or more gas inlets include two gas inlets disposed at respective ends of the heated zone.

15. The system of any one of claims 1 to 14, including a gas storage reservoir configured to temporarily store a quantity of process gas and to subsequently release the stored process gas so as to rapidly increase the pressure within the process tube.

16. The system of any one of claims 1 to 15, wherein the system is configured to use the process gases undiluted in the process tube during deposition.

17. The system of any one of claims 1 to 16, including point of use purifiers to reduce contamination levels of the process gases to ppb levels.

18. The system of any one of claims 1 to 17, including a wafer holder configured to support one or more pairs of wafers in a closely spaced back to back vertical arrangement during deposition, the close spacing between the back surfaces of each pair of wafers being sufficiently small to reduce the deposition thickness on the back surfaces and sufficient large to facilitate evacuation of the process tube.

19. The system of any one of claims 1 to 18, including one or more wafer holders with sets of mutually spaced v-grooves for supporting wafers in a closely spaced back to back vertical arrangement during deposition, wherein the sets of v-grooves have respective different spacings between adjacent v-grooves to enable selection of a desired wafer spacing to provide a corresponding deposition thickness on the back surfaces of the wafers and thereby to provide a corresponding stress asymmetry between the opposite faces of each wafer.

20. The system of any one of claims 1 to 19, wherein the system is configured to deposit successive layers of a semiconductor with respective opposite doping polarities whilst maintaining the at least one sample within the process tube and under vacuum.

21. The system of any one of claims 1 to 20, wherein gas flow in the system is controlled by mass flow controllers via multiple gas manifolds and multiple bypass pumping arrangements to enable each of a plurality of process gas flows to independently stabilise while bypassing the process tube, before switching the stabilised process gas flow into the process tube.

22. The system of any one of claims 1 to 21, wherein the material is silicon carbide.

23. The system of claim 22, wherein the material is silicon carbide and the at least one sample is at least one single-crystal silicon wafer, the silicon carbide being device quality single-crystal silicon carbide deposited epitaxially on the at least one single-crystal silicon wafer.

24. A chemical vapour deposition process, including:

placing a sample in a process tube constructed of silicon carbide, impregnated with silicon, and coated with silicon carbide to provide vacuum integrity;

evacuating the process tube from respective ends thereof simultaneously, and at a pumping speed and pumping conductance such that, in combination with the vacuum integrity of the process tube, the process tube is evacuated to a high vacuum base pressure in the 10^{-6} mBar range or lower;

heating the evacuated process tube and thereby heating the at least one sample within the evacuated process tube; and

introducing one or more process gases into the evacuated and heated process tube to cause a material to be deposited onto the heated at least one sample within the process tube by chemical vapour deposition.

25. The process of claim 24, wherein during deposition the process tube is simultaneously pumped from respective ends, and the one or more process gases are simultaneously introduced into a flat zone of substantially constant temperature within the process tube from respective ends of the flat zone to improve the wafer to wafer uniformity of the deposited material.

26. The process of claim 24, wherein the material is deposited on the at least one sample in a flat zone of substantially constant temperature within the process tube, and the material is deposited as one or more pairs of successive layers of the material, wherein the net gas flows through the flat zone during deposition of successive layers of each pair are in opposite directions to improve the wafer to wafer uniformity of the deposited material.

27. The process of any one of claims 24 to 26, including releasing a quantity of stored process gas into the process tube to rapidly increase pressure within the process tube.

28. The process of any one of claims 24 to 27, wherein the one or more process gases are used undiluted in the process tube during deposition.

29. The process of any one of claims 24 to 28, wherein the at least one sample includes a plurality of wafers, and the process includes supporting the wafers in a closely spaced back to back vertical arrangement during deposition, the close spacing between the back surfaces of each pair of wafers being sufficiently small to reduce the deposition thickness on the back surfaces of the wafers and sufficiently large to facilitate evacuation of the process tube.

30. The process of any one of claims 24 to 29, wherein the at least one sample includes a plurality of wafers, and the process includes supporting the wafers in a mutually spaced arrangement during deposition so that the material is deposited substantially equally on both sides of each wafer to provide substantially equal stress thereon.

31. The process of any one of claims 24 to 30, including depositing successive layers of a semiconductor with respective opposite doping polarities whilst maintaining the at least one sample within the process tube and under vacuum.

32. The process of any one of claims 24 to 31, wherein the material is silicon carbide.

33. The process of any one of claims 24 to 32, wherein the at least one sample includes at least one single-crystal silicon wafer, and the material is device quality single-crystal silicon carbide deposited epitaxially on the at least one single-crystal silicon wafer.

34. A chemical vapour deposition system having components configured for performing the process of any one of claims 24 to 33.