CLAIMS

1. A method of manufacturing a germanium-on-insulator substrate, comprising:

(i) providing a first semiconductor substrate, and a second semiconductor substrate formed with a germanium layer;

(ii) bonding the first semiconductor substrate to the second semiconductor substrate using at least one dielectric material to form a combined substrate, the germanium layer being arranged intermediate the first and second semiconductor substrates;

(iii) removing the second semiconductor substrate from the combined substrate to expose at least a portion of the germanium layer with misfit dislocations;

(iv) annealing the combined substrate to enable removal of the misfit dislocations from the portion of the germanium layer; and

(v) etching the combined substrate to remove a layer of material formed on the portion of the germanium layer as a result of the annealing to enable removal of the misfit dislocations from the portion of the germanium layer, wherein the layer of material substantially includes the misfit dislocations.

2. The method of claim 1, further comprising depositing the at least one dielectric material respectively to the first and second semiconductor substrates prior to the bonding, wherein the at least one dielectric material is deposited on the germanium layer for the second semiconductor substrate.

3. The method of claim 2, wherein the at least one dielectric material includes at least first and second dielectric materials, the first dielectric material being deposited on the first semiconductor substrate, and the second dielectric material being deposited on the germanium layer for the second semiconductor substrate, and wherein the first dielectric material is different to the second dielectric material.

4. The method of claim 1, wherein prior to the bonding, further comprising: performing plasma activation on the first and second semiconductor substrates; washing the first and second semiconductor substrates with a deionized fluid; and drying the washed first and second semiconductor substrates.

5. The method of claim 1, wherein prior to removing the second semiconductor substrate from the combined substrate, further comprising annealing the combined substrate to increase the bonding between the first and second semiconductor substrates.

6. The method of claim 5, wherein annealing the combined substrate to increase the bonding includes performing the annealing using nitrogen at a temperature of about 300°C and at atmospheric pressure.

7. The method of claim 1, wherein the at least one dielectric material is selected from the group consisting of aluminium oxide, aluminium nitrate, silicon dioxide, synthetic diamond and boron nitride.

8. The method of claim 1, wherein the first and second semiconductor substrates are respectively formed from silicon-based materials.

9. The method of claim 1, wherein the annealing is performed at a temperature between about 500°C to 850°C.

10. The method of claim 1, further comprising: depositing a layer of protective material on the first semiconductor substrate, prior to removing the second semiconductor substrate from the combined substrate.

11. The method of claim 10, further comprising removing the protective material from the first semiconductor substrate using oxygen plasma configured with a power of about 800 W.

12. The method of claim 1, wherein etching the combined substrate includes wet etching using an etchant to remove the layer of material formed on the portion of the germanium layer, and the etchant includes hydrofluoric acid.

13. The method of claim 1, wherein removing the second semiconductor substrate from the combined substrate comprises: arranging the combined substrate to be in a solution of tetramethylammonium hydroxide to remove the second semiconductor substrate; and performing an etch-stopping on the exposed portion of the germanium layer.

14. The method of claim 13, wherein the solution is heated to a temperature of about 80°C.

15. The method of claim 1, wherein removing the second semiconductor substrate from the combined substrate comprises using a combination of mechanical grinding and wet etching to remove the second semiconductor substrate.

16. The method of claim 1, further comprising depositing the germanium layer on the second semiconductor substrate, prior to the bonding.

17. A method of manufacturing a germanium-on-insulator substrate, comprising:

(i) providing a first semiconductor substrate, and a second semiconductor substrate formed with a germanium layer;

(ii) bonding the first semiconductor substrate to the second semiconductor substrate using at least one dielectric material to form a combined substrate, the germanium layer being arranged intermediate the first and second semiconductor substrates;

(iii) removing the second semiconductor substrate from the combined substrate to expose at least a portion of the germanium layer with misfit dislocations;

(iv) annealing the combined substrate to enable removal of the misfit dislocations from the portion of the germanium layer, wherein the method further comprises forming a further dielectric material on the portion of the germanium layer, subsequent to removing the second semiconductor substrate, and prior to annealing the combined substrate.

18. A method of manufacturing a germanium-based substrate, comprising:

(i) providing a first semiconductor substrate, and a second semiconductor substrate formed with a germanium layer;

(ii) bonding the first semiconductor substrate to the second semiconductor substrate using at least one bonding material to form a combined substrate, the germanium layer being arranged intermediate the first and second semiconductor substrates;

(iii) removing the second semiconductor substrate from the combined substrate to expose at least a portion of the germanium layer with misfit dislocations;

(iv) annealing the combined substrate to enable removal of the misfit dislocations from the portion of the germanium layer; and

(v) etching the combined substrate to remove a layer of material formed on the portion of the germanium layer as a result of the annealing to enable removal of the misfit dislocations from the portion of the germanium layer, wherein the layer of material substantially includes the misfit dislocations.

19. The method of claim 18, wherein the bonding material includes a dielectric material, a non-dielectric material, a plurality of different non-dielectric materials, or a plurality of different dielectric materials.