Claims

1. A hybrid photonic chip comprising:

a first part of the chip comprising silicon and electrodes; and

a second part of the chip comprising a nonlinear crystal material, wherein the second part of the chip has not been subjected to etching;

wherein the second part of the chip has been applied to the first part of the chip via a flip-chip bonding technique,

wherein the second part of the chip in conjunction with the first part of the chip is configured to support a propagating single mode.

2. The hybrid photonic chip according to claim 1, wherein the nonlinear crystal material includes at least one of: lithium niobate ($LiNbO_3$), lithium tantalate ($LiTaO_3$), potassium niobate ($KNbO_3$), barium titanate ($BaTiO_3$), potassium titanyl phosphate ($KTiOPO_4$), barium borate (BaB_2O_4).

3. The hybrid photonic chip according to claim 1, wherein the first part of the chip comprises one or more silicon strips on a silicon on insulator, SOI, platform that do not support the propagating single mode alone.

4. The hybrid photonic chip according to claim 3, wherein the second part of the chip and the one or more silicon strips support the propagating single mode together.

5. The hybrid photonic chip according to any of claims 1 to 4, wherein the hybrid chip is a modulator.

6. The hybrid photonic chip according to claim 5, wherein the second part of the chip is a waveguide configured to substantially support the propagating single mode primarily in the nonlinear crystal material.

7. The hybrid photonic chip according to claim 5 or claim 6, wherein the modulator is a Mach Zehnder modulator.

8. The hybrid photonic chip according to claim 1, wherein the electrodes are located in gaps in a buried oxide of the first part of the chip to receive bonding pads from the second part of the chip.

9. The hybrid photonic chip according to claim 1, wherein the electrodes are connected to the second part of the chip during the flip-chip bonding technique.

10. A method of fabricating a hybrid photonic chip, that excludes the etching of the nonlinear crystal material, the method comprising:

forming a first part of a chip from silicon using a CMOS fabrication process;

forming electrodes as a part of the first part of the chip: and

applying a second part of the chip comprising a nonlinear crystal material to the first part of the chip by a flip-chip bonding technique, wherein the nonlinear crystal material is not subjected to etching ;

wherein the second part of the chip in conjunction with the first part of the chip substantially supports a propagating single mode.

11. The method of claim 10, wherein the nonlinear crystal material (x^2 material) includes at least one of: lithium niobate ($LiNbO_3$), lithium tantalate ($LiTaO_3$), potassium niobate ($KNbO_3$), barium titanate ($BaTiO_3$), potassium titanyl phosphate ($KtiOPO_4$), barium borate (BaB_2O_4).

12. The method of any of claims 10 or 11, further comprising forming one or more silicon strips on a SOI platform that do not support the propagating single mode alone.

13. The method of any of claims 10 to 12, further comprising forming the hybrid chip as a modulator.

14. The method of claim 13, further comprising forming the second part of the chip as a waveguide configured to substantially support the propagating single mode.

15. The method of claim 13 or claim 14, further comprising forming the modulator as a Mach Zehnder modulator.

16. The method according to claim 10, further comprising etching gaps into a buried oxide layer of a SOI platform in the first part of the chip; forming the electrodes located in the gaps in the buried oxide of the first part of the chip to receive bonding pads from the second part of the chip.

17. The method according to claim 10, wherein the electrodes are connected to the second part of the chip during the flip-chip bonding technique.

18. A process design kit for forming a hybrid photonic chip of claim 1, comprising:

parameters to form the first part of the chip comprising silicon and electrodes using a CMOS fabrication process,

parameters to form the second part of the chip comprising a nonlinear crystal material; and

parameters to integrate the first and second parts of the chip by a flip-chip bonding technique, wherein the nonlinear crystal material is not subjected to etching, wherein the process design kit is configured to integrate the first part of the chip with the second part of the chip to support a propagating single mode.

19. A computer readable storage medium having stored thereon, a computer readable description of a hybrid photonic chip that, when processed in chip fabrication system, causes chip fabrication system to execute the method according to claim 10.