CLAIMS

1. A monolithic microwave integrated circuit, MMIC, front-end module ~~(100)~~ comprising:

a gallium nitride structure ~~(110)~~ supported by a silicon substrate ~~(120)~~;

a silicon-based transmit/receive switch ~~(130)~~ having a transmit mode and a receive mode;

a transmit amplifier ~~(112)~~ configured to amplify an outgoing signal to be transmitted by said MMIC front-end module, wherein said transmit amplifier is electrically connected ~~(132)~~ to said transmit/receive switch, wherein said transmit amplifier comprises a gallium nitride high-electron-mobility transistor, HEMT, ~~(114)~~ formed in said gallium nitride structure;

a receive amplifier ~~(113)~~ configured to amplify an incoming signal received by said MMIC front-end module, wherein said receive amplifier is electrically connected ~~(133)~~ to said transmit/receive switch, wherein said receive amplifier comprises a gallium nitride HEMT ~~(115)~~ formed in said gallium nitride structure;

a silicon-based frequency up-converter ~~(342)~~, electrically connected ~~(332)~~ to said transmit amplifier ~~(112)~~, wherein said frequency up-converter ~~(342)~~ is configured to up-convert a frequency of said outgoing signal to be transmitted by said MMIC front-end module ~~(100)~~; and

a silicon-based frequency down-converter ~~(343)~~, electrically connected ~~(333)~~ to said receive amplifier ~~(113)~~, wherein said frequency down-converter (343) is configured to down-convert a frequency of the incoming signal received by said MMIC front-end module ~~(100)~~.

2. The MMIC front-end module according to claim 1, wherein said transmit amplifier comprises a plurality of HEMTs formed in said gallium nitride structure.

3. The MMIC front-end module according to ~~any one of~~ claim~~s~~ 1~~-2~~, wherein said receive amplifier comprises a plurality of HEMTs formed in said gallium nitride structure.

4. The MMIC front-end module according to ~~any one of the previous~~ claim 1~~s~~, wherein said gallium nitride structure supported by said silicon substrate comprises a first gallium nitride island ~~(211)~~ and a second gallium nitride island ~~(212)~~, wherein said first gallium nitride island and said second gallium nitride island are physically separated and laterally co-arranged on the silicon substrate.

5. The MMIC front-end module according to claim 4, wherein said gallium nitride HEMT of said transmit amplifier is formed in the first gallium nitride island, and wherein said gallium nitride HEMT of said receive amplifier is formed in said second gallium nitride island.

6. The MMIC front-end module according to ~~any one of~~ claim~~s~~ 4~~-5~~, wherein said first gallium nitride island and said second gallium nitride island has a lateral dimension in the range from 0.1µm to 10µm.

7. The MMIC front-end module according to ~~any one of the previous~~ claim~~s~~ 1, wherein said gallium nitride structure has a lateral dimension in the range from 0.1µm to 10µm.

8. The MMIC front-end module according to ~~any one of the previous~~ claim~~s~~ 1 further comprising an antenna ~~(451)~~ configured to transmit and receive wireless signals wherein said transmit/receive switch is electrically connected ~~(453)~~ to said antenna.

9. The MMIC front-end module according to claim 8, wherein said antenna is supported by said silicon substrate.

10. The MMIC front-end module according to ~~any one of~~ claim~~s~~ 8~~-9~~, wherein said antenna is an array antenna, said array antenna comprising a plurality of antenna array elements ~~(455)~~.

11. The MMIC front-end module according to ~~any one of the previous~~ claim~~s~~ 1, wherein said gallium nitride structure comprises a vertical nanowire structure (516) arranged perpendicularly to said silicon substrate.

12. The MMIC front-end module according to ~~any one of the previous~~ claim~~s~~ 1, wherein said gallium nitride structure comprises a gallium nitride layer ~~(517)~~ and an $Al_xGa_{1-x}N$ layer (518), wherein $0 \leq x \leq 0.95$.

13. The MMIC front-end module according to ~~any one of the previous~~ claim~~s~~ 1, wherein said gallium nitride structure comprises an aluminium nitride layer ~~(519)~~.

14. The MMIC front-end module according to ~~any one of the previous~~ claim~~s~~ 1, wherein the silicon-based transmit/receive switch is integrally formed into the silicon substrate or wherein the silicon-based transmit/receive switch is supported by the silicon substrate.

15. A monolithic microwave integrated circuit, MMIC, front-end module ~~(100)~~ comprising:

a gallium nitride structure ~~(110)~~ supported by a silicon substrate ~~(120)~~, wherein said gallium nitride structure supported by said silicon substrate comprises a first gallium nitride island ~~(211)~~ and a second gallium nitride island ~~(212)~~, wherein said first gallium nitride island and said second gallium nitride island are physically separated and laterally co-arranged on the silicon substrate;

a silicon-based transmit/receive switch ~~(130)~~ having a transmit mode and a receive mode;

a transmit amplifier ~~(112)~~ configured to amplify an outgoing signal to be transmitted by said MMIC front-end module, wherein said transmit amplifier is electrically connected ~~(132)~~ to said transmit/receive switch, wherein said transmit amplifier comprises a gallium nitride high-electron-mobility transistor, HEMT, ~~(114)~~ formed in said gallium nitride structure; and

a receive amplifier (113) configured to amplify an incoming signal

received by said MMIC front-end module, wherein said receive amplifier is electrically connected ~~(133)~~ to said transmit/receive switch, wherein said receive amplifier comprises a gallium nitride HEMT ~~(115)~~ formed in said gallium nitride structure.

16. A monolithic microwave integrated circuit, MMIC, front-end module ~~(100)~~ comprising:

a gallium nitride structure ~~(110)~~ supported by a silicon substrate ~~(120)~~, wherein said gallium nitride structure comprises a vertical nanowire structure ~~(516)~~ arranged perpendicularly to said silicon substrate;

a silicon-based transmit/receive switch ~~(130)~~ having a transmit mode and a receive mode;

a transmit amplifier ~~(112)~~ configured to amplify an outgoing signal to be transmitted by said MMIC front-end module, wherein said transmit amplifier is electrically connected ~~(132)~~ to said transmit/receive switch, wherein said transmit amplifier comprises a gallium nitride high-electron-mobility transistor, HEMT, ~~(114)~~ formed in said gallium nitride structure; and

a receive amplifier ~~(113)~~ configured to amplify an incoming signal received by said MMIC front-end module, wherein said receive amplifier is electrically connected ~~(133)~~ to said transmit/receive switch, wherein said receive amplifier comprises a gallium nitride HEMT ~~(115)~~ formed in said gallium nitride structure.