CLAIMS:

1. An apparatus comprising:

a housing;

a substrate mounted within the housing;

a plurality of sensor fibers secured to the substrate, each sensor fiber including:

an optical waveguide; and

an optical sensor structure configured for:

detecting an acoustic signal, and

providing an optical signal corresponding to the acoustic signal to the optical waveguide, and

a plurality of electro-mechanical acoustic energy generating transducers disposed adjacent to the plurality of sensor fibers within the housing and configured to generate acoustic energy, wherein

each optical sensor structure is provided at a distal tip of a corresponding sensor fiber,

the plurality of sensor fibers are arranged axially within the housing, and

the plurality of sensor fibers are arranged in a first row to form a first linear fiber optical sensor array and a second row to form a second linear fiber optical sensor array, the first linear optical sensor array and the second linear fiber optical sensor array being displaced from one another in an elevation dimension on opposite sides of the plurality of acoustic energy generating transducers to provide 1.5D imaging.

2. The apparatus of claim 1, wherein each optical sensor structure is further configured for:

detecting a physical parameter, and providing an optical signal corresponding to the physical parameter to the optical waveguide.

3. The apparatus of claim 1, wherein the substrate includes:

a first portion configured to cover the plurality of sensor fibers; and

a second portion attached to the first portion and having a plurality of fiber optic sensor receiving portions corresponding to the plurality of sensor fibers.

4. The apparatus of claim 1, further comprising an interface layer disposed within the housing as an exterior layer of the apparatus between the plurality of sensor fibers and a surrounding environment.

5. The apparatus of claim 4, wherein the interface layer comprises one or more of a moisture barrier, an electrical isolator, a matching layer, a couplant and an acoustic lens.

6. The apparatus of claim 1, further comprising an interface layer disposed within the housing as an exterior layer of the apparatus between the plurality of acoustic energy generating transducers and a surrounding environment.

7. The apparatus of claim 6, wherein the interface layer comprises one or more of a moisture barrier, an electrical isolator, a matching layer, a couplant and an acoustic lens.

8. The apparatus of claim 1, wherein:

each optical sensor structure is provided at a distal tip of a corresponding sensor fiber, and distal portions of the plurality of sensor fibers are arranged in an elevation dimension within the housing.

9. An apparatus comprising:

a housing;

a substrate mounted within the housing;

a plurality of sensor fibers secured to the substrate, each sensor fiber including:

an optical waveguide, and

an optical sensor structure configured for:

detecting an acoustic signal, and

providing an optical signal corresponding to the acoustic signal to the optical waveguide, and

a plurality of electro-mechanical acoustic energy generating transducers disposed adjacent to the plurality of sensor fibers within the housing and configured to generate acoustic energy, wherein:

each sensor fiber of the plurality of sensor fibers further includes an encapsulating structure surrounding the optical waveguide,

each optical sensor structure includes an exposed portion defined by a lack of the encapsulating structure, and

each optical sensor structure is a polarization based fiber sensor configured to receive the acoustic signal at the exposed portion and to cause an alteration in polarization of the optical signal traveling through the optical waveguide in response to the acoustic signal.

10. The apparatus of claim 9, wherein each sensor fiber includes a plurality of exposed portions spaced apart in the lateral dimension.

11. An apparatus comprising:

a housing;

a substrate mounted within the housing;

a plurality of sensor fibers secured to the substrate, each sensor fiber including:

an optical waveguide, and

an optical sensor structure configured for:

detecting an acoustic signal, and

providing an optical signal corresponding to the acoustic signal to the optical waveguide, and

a plurality of electro-mechanical acoustic energy generating transducers disposed adjacent to the plurality of sensor fibers within the housing and configured to generate acoustic energy, wherein:

proximal portions of the plurality of sensor fibers extend through the housing in an axial dimension,

the substrate is configured to maintain a bend in each of the plurality of sensor fibers such that distal portions of the plurality of sensor fibers are disposed along an elevation dimension of the housing, and the plurality of sensor fibers are configured to receive the acoustic signal from directions lateral to the axes of the plurality of sensor fibers.

12. An apparatus comprising:

a housing;

a substrate mounted within the housing;

a plurality of sensor fibers secured to the substrate, each sensor fiber including:

an optical waveguide, and

an optical sensor structure configured for:

detecting an acoustic signal, and

providing an optical signal corresponding to the acoustic signal to the optical waveguide, and

a plurality of electro-mechanical acoustic energy generating transducers disposed adjacent to the plurality of sensor fibers within the housing and configured to generate acoustic energy, wherein:

proximal portions of the plurality of sensor fibers extend through the housing in an axial dimension,

the substrate is configured to maintain a bend in each of the plurality of sensor fibers such that distal portions of the plurality of sensor fibers are disposed along a lateral dimension of the housing, and

the plurality of sensor fibers are configured to receive the acoustic signal from directions lateral to the axes of the plurality of sensor fibers.

13. An apparatus comprising:

a housing;

a substrate mounted within the housing;

a plurality of sensor fibers secured to the substrate, each sensor fiber including:

an optical waveguide, and

an optical sensor structure configured for:

detecting an acoustic signal, and

providing an optical signal corresponding to the acoustic signal to the optical waveguide, and

a plurality of electro-mechanical acoustic energy generating transducers disposed adjacent to the plurality of sensor fibers within the housing and configured to generate acoustic energy further comprising at least one heater disposed adjacent to the plurality of sensor fibers and configured to be controlled to provide thermal tuning to at least one of the plurality of sensor fibers.

14. The apparatus of claim 13, wherein the at least one heater includes a plurality of heaters, each disposed adjacent to a corresponding one of the plurality of sensor fibers and configured to be individually controlled to provide thermal tuning to the corresponding one of the plurality of sensor fibers.

15. An apparatus comprising:

a housing;

a substrate mounted within the housing, wherein the substrate is a chip;

a plurality of sensor fibers secured to the substrate, each sensor fiber including:

an optical waveguide;

an optical sensor structure comprising a single shared optical sensor structure for the plurality of sensor fibers, wherein the plurality of sensor fibers is configured for

detecting an acoustic signal, and

providing an optical signal corresponding to the acoustic signal to the optical waveguide; and

a plurality of electro-mechanical acoustic energy generating transducers configured to generate acoustic energy.

16. The apparatus of claim 15, wherein each optical sensor structure is further configured for:
detecting a physical parameter, and
providing an optical signal corresponding to the physical parameter to the optical waveguide.

17. The apparatus of claim 15, further comprising an interface layer disposed within the housing as an exterior layer of the apparatus between the plurality of sensor fibers and a surrounding environment, the interface layer including one or more of a moisture barrier, an electrical isolator, a matching layer, a couplant and an acoustic lens.

18. The apparatus of claim 15, further comprising an interface layer disposed within the housing as an exterior layer of the apparatus between the plurality of acoustic energy generating transducers and a surrounding environment.

19. The apparatus of claim 18, wherein the interface layer comprises one or more of a moisture barrier, an electrical isolator, a matching layer, a couplant and an acoustic lens.

20. The apparatus of claim 15, wherein:
the optical sensor structure is provided at a distal tip of a corresponding sensor fiber, and
the plurality of sensor fibers are arranged along an axial direction within the housing.

21. The apparatus of claim 15, wherein distal portions of the plurality of sensor fibers are disposed along an elevation dimension within the housing.

22. The apparatus of claim 15, wherein distal portions of the plurality of sensor fibers are disposed along a lateral dimension within the housing.

23. The apparatus of claim 15, further comprising at least one heater disposed adjacent to the plurality of sensor fibers and configured to be controlled to provide thermal tuning to at least one of the plurality of sensor fibers.

24. The apparatus of claim 23, wherein the at least one heater includes a plurality of heaters, each disposed adjacent to a corresponding one of the plurality of sensor fibers and configured to be individually controlled to provide thermal tuning to the corresponding one of the plurality of sensor fibers.