CLAIMS

What is claimed is:

1. A semiconductor device, comprising:

a three-dimensionally printed flip chip interconnect that includes an electrically conductive ink material that is compatible with a three-dimensional printing technology, the three-dimensionally printed flip chip interconnect located on a metal surface of a semiconductor chip.

2. The semiconductor device of claim 1, wherein the three-dimensional printing technology is a direct write printing technology, an inkjet printing technology, or an aerosol jet printing technology.

3. The semiconductor device of claim 1, wherein the electrically conductive ink material comprises at least one member selected from the group consisting of: gold, aluminum, copper, tantalum, cobalt, ruthenium, titanium, tin, silver, solder, or an alloy thereof.

4. The semiconductor device of claim 3, wherein the three-dimensionally printed flip chip interconnect is cylindrically shaped.

5. The semiconductor device of claim 1, wherein the metal surface is a chip pad comprising at least one metal selected from the group consisting of: gold, aluminum, copper, tungsten, tantalum, silver, and palladium.

6. The semiconductor device of claim 1, wherein the three-dimensionally printed flip chip interconnect further includes a second electrically conductive ink material that is also compatible with the three-dimensional printing technology.

7. The semiconductor device of claim 1, wherein a distal end of the three-dimensionally printed flip chip interconnect has a polygon shaped surface.

8. A method to fabricate a semiconductor, comprising:
forming a flip chip interconnect by depositing an electrically conductive ink material onto a chip pad of a semiconductor device, wherein the depositing is performed via a three-dimensional printing technology.

9. The method of claim 8, further comprising:
forming the chip pad by depositing a metal onto a semiconductor substrate, wherein the metal comprises at least one member from the group consisting of: gold, aluminum, copper, tungsten, tantalum, silver, and palladium.

10. The method of claim 9, further comprising: generating a printing map that defines a location of the chip pad on a semiconductor chip, wherein the electrically conductive ink material is deposited via the three-dimensional printing technology based on the printing map.

11. The method of claim 8, wherein the electrically conductive ink material comprises at least one
member selected from the group consisting of: gold, aluminum, copper, tantalum, cobalt, ruthenium, titanium, tin, silver, or an alloy thereof.

12. The method of claim 8, wherein the three-dimensional printing technology is a direct write printing technology, an inkjet printing technology, or an aerosol jet printing technology.

13. A method of processing a semiconductor, comprising:
tuning a resonator of a semiconductor device by depositing an ink material onto a surface of the resonator, wherein the depositing is performed via a three-dimensional printing technology.

14. The method of claim 13, further comprising: providing a resonator, the resonator comprising an electrode adjacent to a piezoelectric layer, wherein the ink material is deposited onto at least one of: the electrode, and the piezoelectric layer.

15. The method of claim 13, further comprising:

generating a printing map that defines a location of the resonator on a semiconductor chip, wherein the ink material is deposited via the three- dimensional printing technology based on the printing map.