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(54) Title: 3D PRINTING TECHNIQUES FOR FORMING INTERCONNECTS FOR FLIP-CHIP ASSEMBLIES OR TUNING RESONATORS OF A SEMICONDUCTOR DEVICE

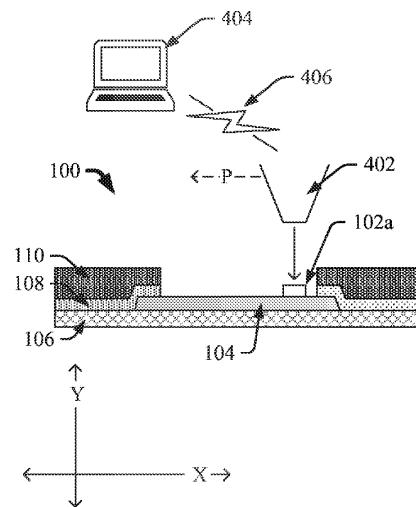


FIG. 4A

(57) Abstract: In an embodiment, a semiconductor device (100) comprises a three- dimensionally printed flip chip interconnect (102) that includes an electrically conductive ink material that is compatible with a three-dimensional printing technology, the three-dimensionally printed flip chip interconnect (102) being located on a metal surface (chip pad) (104) of a semiconductor chip. The three-dimensional printing technology may be a direct write printing technology, an inkjet printing technology, or an aerosol jet printing technology. The three-dimensionally printed flip chip interconnect (102) may have a cylindrical shape. A distal end (202) of the three-dimensionally printed flip chip interconnect (102) may have a polygon shaped surface. A printing map (700) that defines a location of the chip pad (104) on the semiconductor chip may be generated, wherein the electrically conductive ink material is deposited via the three- dimensional printing technology based on the printing map (700). Example semiconductor devices can include, but are not limited to: a bulk acoustic wave device, a monolithic microwave integrated circuit, an integrated circuit, a passive integrated circuit, a microelectrochemical system, a magnetic material-based circuit, a combination thereof, and/or the like. The chip may further include one or more semiconductor features including, but not limited to: resonators, resistors, capacitors, inductors, a combination thereof, and/or the like. In a further embodiment, a method of processing a semiconductor comprises tuning a resonator (800) of a semiconductor device by depositing an ink material onto a surface of the resonator (800), wherein the depositing is performed via a three-dimensional printing technology. The resonator (800) may comprise an electrode (804) adjacent to a piezoelectric layer (802), wherein the ink material is deposited onto at least one of: the electrode (804) and the piezoelectric layer (802). A printing map (700) that defines a location of the resonator (800) on a semiconductor chip

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may be generated, wherein the ink material may be deposited via the three-dimensional printing technology based on the printing map (700).