3D-Printed Technology for Advanced Packaging

Rethinking Packaging

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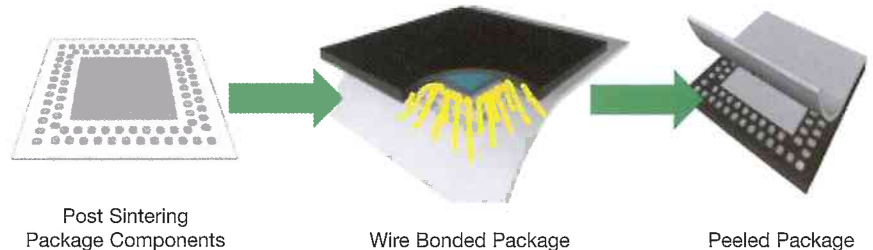

3D PRINTING TECHNOLOGY HAS been around for some time now and is being used for prototype development in various markets ranging from automobile parts to fabric-based toys. However, the semiconductor packaging industry has yet to see the adoption of 3D-printed manufacturing platforms. The difficulty in adopting this technology for packaging is the fact that current 3D printing technology has been a low volume manufacturing process. Semiconductor products require millions of parts to be made quickly and cost effectively, so the ability to produce in high volume is extremely important. Until now, the high volume 3D printing technology necessary to make this viable has not been available. 3D printing provides interesting possibilities in packaging, where performance, size, cost, and time to market are key drivers. The potential for 3D-printed technology is significant, as there is a constant pressure to meet the complex design requirements and rigorous performance demands in smaller and smaller packages – compounded by trends in the mobility and IOT spaces.

Recognizing this demand and need from the market, EoPlex, Inc. has developed a 3D High Volume Print Forming technology and the CSI™ platform that will transform the manufacturing, and speed at which packages are built. EoPlex uses a unique print forming process that yields 3D printed frames consisting of arrayed package components deposited on a temporary carrier. Packages made with this process are similar to its etched leadframe counterparts, except that components are printed as a paste and sintered to form solid structures suitable for gold and copper wire bonding. The process begins with a mold set on a stainless steel carrier, which is then filled with a proprietary robust conductor material that is precisely printed and densified during sintering. The sintered package components use the standard assembly flow for leadframe packages for die attach, wire bonding and molding, and the steel carrier is easily peeled away after molding, leaving behind a clean, solder-ready surface for surface mount assembly.

Several main benefits of the platform for common package types are the reduction in crosstalk noise from antenna-like tie bar stubs, and the accommodation of more bond pad rows that are limited only by PC board routing and the wire bond length determined by manufacturing rules. This platform allows for more than 3 rows of bond pads and enables a size reduction of up to 33% compared to conventional QFN leadframes for certain designs. In many cases, the wire bond length can be reduced significantly when compared to a traditional QFN type package. This translates into a reduction in return loss that improves the package frequency capability by over 1 GHz. The wire bond inductance is also reduced proportionately, providing lower impedance. The ability to print isolated metal bars and rings provides the advantage of multiple low impedance power domains in a single layer lead frame type package. The result is that the signal integrity is comparable or superior to some 4-layer wire bonded BGA packages.

The importance of 3D-printing for packaging may seem questionable at first, especially when so many packaging options already exist. However, the answer to this is quite simple – current packaging options simply do not meet the needs of the high performance low cost market. 3D printed technology, however, is an ideal solution to market requirements that are driven by performance, reduced size, and diverse form factors.

For current and advanced packaging, 3D printing represents not only benefits in process efficiencies, but also increased design freedom. The EoPlex CSI™ platform is extremely adaptable, and has potential for many applications in space-constrained devices. For example, it may be possible to replace larger, costlier packages such as BGA and QFP with smaller, less expensive QFN packaging because with this platform it is possible to fit more bond pads in the same package size.

With the rise of the Connected World and growing demand in IOT, the semiconductor industry is bracing itself for a wave of demand in powerful miniaturized devices to drive high performance consumer, automotive, and medical devices. Packaging plays an important role in interconnect and protection of advanced ICs. Thus, advanced technologies and manufacturing platforms are necessary to improve existing package types and enable new packaging options. The availability of a robust 3D-printed technology and flexible manufacturing platform like CSI™ enables unique innovation within the mature packaging industry to meet the needs of the increasingly demanding mobility market.

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