

Multifunctional 3D Packages for Microsystems

Laser Technologies for Finest Pitches

Polymer based multifunctional 3D packages made by MID (Molded Interconnect Devices) technology combine high functionality and miniaturization at effective cost. Injection molding of polymers is suitable for 3D applications made from thermoplastic. Laser technologies are well suited for patterning fine lines on 3D parts for assembling SMD and bare die. Furthermore with laser techniques layout changes can be performed easily. With laser direct structuring (LDS) as well as the semi additive and subtractive patterning process both free-forming surfaces and geometries with high angles can be processed.

LDS is a full additive process. The plastic part is made by injection molding of a polymer with special additives. At present, polymers as e.g. LCP, PBT/PET and PA6/6T are commercial available for this technology. These polymers can be used in a common lead free soldering process.

The LDS process starts with a selective activation of the polymer surface with an infrared laser beam with a dynamic z axis. The activated areas are metallized by electroless plating afterwards. Electroless copper is deposited first and subsequently electroless plated with nickel and gold. A good adhesion of the metal layers results from anchorage of the copper to the roughened surface. At present, with the LDS process minimum line widths and spaces of 200 µm can be obtained in serial production.

LDS enables also the fabrication of micro vias with the same process. The infrared laser beam can be used for drilling the holes in the plastic part first and then for activating the conductive pattern. While drilling the holes, the side walls are activated. Micro vias with diameters down to 50 µm can be fabricated. Vias with much larger diameters can be fabricated by injection molding of conic shaped holes followed by activating and electroless plating the side walls of the holes.

Molded Interconnect Devices (MID)

- Higher functionality
- Higher level of integration
- Reduction of cost
- Reduction of weight
- Smaller package sizes

Laser MID

- 3D MID technology for finest pitches
- Patterning of the 3D circuitry by
 - Laser Direct Structuring (LDS)
 - Subtractive laser patterning
 - Semi additive laser patterning
- Micro vias available by laser drilling

Laser Direct Structuring (LDS)

Source: HSG-IMAT, Bosch

Ø 240 µm Ø 50 µm

Semi additive laser technology

1 mm

Subtractive laser technology

2 mm

Source: MIDEE, EADS, HSG-IMAT

With the subtractive process, after one shot injection molding the plastic part is completely electroless plated with copper, nickel and gold. A fine focused ultraviolet laser beam is used for patterning the metal layer by an ablation process.

Compared to the subtractive laser process, less laser processing time is required using the semi additive process because here only a thin metal

starting layer has to be removed. The starting layer can be deposited by electroless plating or physical vapour deposition as well. After laser patterning the remaining copper layer is reinforced by electroless nickel and gold. Because the whole surface of the plastic device is coated by metal, subtractive and semi additive technology are well suited for fabricating integrated shieldings.

With the subtractive and semi additive process metal line pitches down to 100 µm can be obtained.