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Printing and Encapsulation Processes for Si-Chip Assembly and Containing on and in Flexible Substrates.

ABSTRACT - Masterthesis

Common techniques for contacting free silicon semiconductor chips on rigid substrates are realized e.g. by wire bonding or in solder reflow processes by using solder balls or printed solder paste. New technologies like printed electronics allow an economic and fast realization of electronic components by using pure additive processes like digital printing as well as cheap, flexible substrates. However, especially highly integrated elements like Integrated Circuits or high volume r/w storage are still not being produced by printing, so that traditional Si based microelectronics have to be combined with printed electronics. In this demanding project suited process modules for (thinned) Si die or flip chip assembly, its contacting and encapsulation on and in flexible/bendable substrate are created and evaluated.

- Existing Si test dies are modified in that way that
 - Al pads are coated with Ni/Au metallization in order to avoid pad oxidation and insulation effects, which also act as bump for the flip chip process.
 - Die wafers are thinned by grinding and CMP, in order to get different die thicknesses (40 μm , 60 μm , 120 μm) and to check the influence of different die thicknesses during testing.
 - Wafers are diced before grinding.
- A layout for printing functional structures on Substrates (PET) is designed and printed. Printing the structures silver ink will be used. This layout serves for chip assembly and testing.
- Different die assemblies, namely flip-chip and die assembly with top mounting (with front side up) are evaluated.
 - Flip-chip technique: Anisotropic conductive (ACAP/ACAF) is used
 - Top mounting: The die is assembled with Epoxy glue, silver lines or conductive lines are established over the conductive pads and the frame of the mounted Si-Chip to achieve the electrical contact.

- The assemblies are tested and improved according to their electrical function/contact. Mechanical cycling test of the foil substrates with the assembled dies are conducted and evaluated.
- At last suited encapsulation procedures and techniques for the dies are evaluated and mechanically tested. The purpose is to set the mounted chip more into the neutral plane of bending of the substrate-chip assembly in order to minimize shear force on the electrical connects.