AEMtec

State of the art and novel wafer level solder bumping techniques

D.Lieske, 13.06.2023
Wafer level bumping..

- is solder bump formation on wafer
- is state of the art for flip chip packaging process
- is the first choice for heterogeneous integration today
- has advantages compared to wire bonding e.g. high pin count, higher signal speed, faster for high volume
- is required for many more applications like Wafer Level Package, FanOut WLP or C2W (Chip to Wafer) and chiplet
- the demand is growing for the next decade
Heterogeneous integration examples

- SiP
- MEMS
- X-Ray
- Sensors
Wafer level bumping – a brief introduction

• Requires a UBM solderable pad surface like NiAu, NiPdAu or Copper
• Contact pitch depending on contact size (400µm...60µm) down to 130µm +/-
• Chip to substrate, RDL interposer or Chip to chip interconnections (e.g. Bunch of wires) possible
• High pin count require fast process solutions, wire bonding for 500+ interconnects is not the best solution for Mass production
• Applications are for computing in nearly every new application and every market segment, (Asic controller, RF applications, image and signal processing,...)
Wafer level bumping process methods

With solder alloys

• UBM + Ball drop (very flexible, fast and less costly, any alloy types, large and small pitch, all SAC, low melting (BiSn, InSn48) and high melting (PbSn10))
• UBM + C4 electroplating (ball or copper pillar bumps, requires lithography, lowest pitch, limited alloy types)
• Solder printing

Others

• Au stud bumping (flexible, low cost, thermocompression)
• Electroless Nickel or NiAu bumping (small pitch, thermocompression e.g. ACF)
Wafer level bumping with Ball drop process

- Process is capable up to 3 Mio bumps per Wafer for 6 – 12 inch wafer

*1) UBM and Wafer level bumping is a qualified process, additionally it has to qualified via package qualification, depending on solder alloy type and application
Typical Combinations of UBM and Solder

- UBM (electroless plating) and solder bumping AEMtec
- UBM (Electroplating) with or without RDL and solder bumping AEMtec
- UBM (Electroplating) solder bumping via plating other OSAT’s

Electroless UBM + Ball drop (AEMtec)
RDL + Ball drop (AEMtec)
Electroplating UBM + Electroplating Solder (other)
Properties of Solder bumping and results

Benefits

• Fast process, no plating chemistry
• Accurate solder bump positions before reflow
• Stable bump height after soldering due to precise preform spheres

bump position before soldering

bump height distribution within +/-5µm (95µm ball diameter)
Properties of Solder bumping and results

Benefits
• Any solder alloy possible, fast exchange of allow type, fast product change
• Process is capable for double sided wafer with surface on backside which must not get into contact with liquids

Con
• Flux cleaning required for water soluble flux or no clean flux possible without cleaning*1)

*1) No clean flux requires qualification with final product assembly process
Basic Applications

- Flip Chip package
- WL-CSP

- Application: SIP/ MCM, Flip Chip package, RF package, Smart systems (optical-, gas-, liquid-, sensors, accelerometers,...), telecommunication, bit coin, medical, ...
Novel Applications

- Silicon photonics
- ADAS
- MEMS

- Different solder sphere diameter on the same wafer is possible *(new)*
- Photonics SIP, HPC (high bandwidth, high speed) AI, autonomous driving, CdTe sensors
Unique wafer level bumping & Semiconductor packaging in Europe
AEMtec Network in Europe & worldwide

- Central Position in Europe
- Worldwide Customer Network
- Strong Institutes Network
- Strong Foundry Network
THANK YOU!

AEMtec GmbH
James-Franck-Str. 10
12489 Berlin

www.aemtec.com