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BiTS Burn-in & Test Strategies Workshop 2017

Development of fan-out layer assembled 100 um pitch BGA socket with 3D MEMS technologies

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Introduction

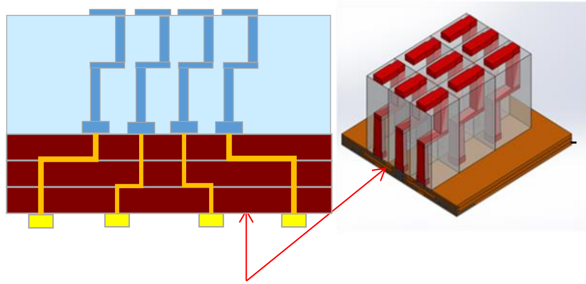
- As the semiconductor chips requires smaller and highly integrated module, the industry required smaller and integrated test socket
- Nowadays, spring pin or 2D MEMS pin assembled test socket, rubber type test socket occupy major role in the market. But, assembled type test socket has the problems of difficult processing and high cost and rubber type test socket has the difficulties to meet market demand of fine pitch.
- We try to make 3D MEMS pin structure with 100 um pitch that satisfies both demand for fine pitch and concerns on the cost.
- Fine pitch under 100 um requires fan-out routing structure for connection to PCB. So, we fabricated fan-out RDL structure and MEMS pin together.
- Realized socket has minimized solder ball damage compared to both pogo pin and has good contact resistance.

Challenges

- MEMS type cantilever structures made of full MEMS process (buildup process)
  - Contact resistance ≤ 100 mΩ
  - Ball damage (ball volume loss) ≤ 10%
- 100 um pitch pin array
  - Stable spring action without depress with zero leakage
  - Pin position accuracy < ±2.5 um
- Fan-out RDL structure Integrated pin array
  - Fan-out RDL made of a Polyimide film (1~3 layers)
  - Front side capacitor SMT structure

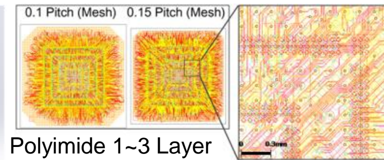
Approach

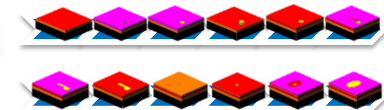
- 3D MEMS pin array structure



Fan-out RDL by polyimide Layer

- Fan-out design & process

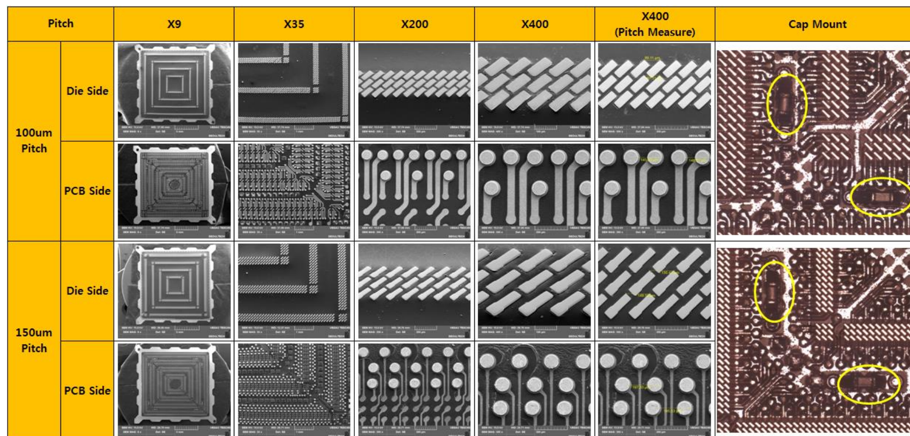




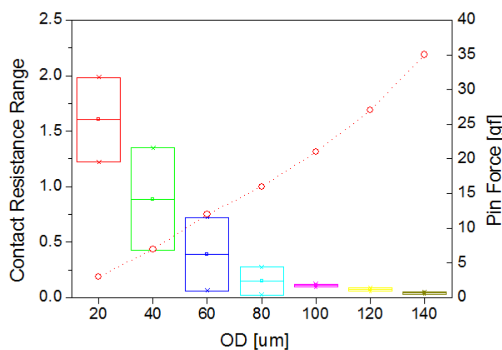
<Photo litho process for Polyimide RDL>

Experimental Results

- MEMS pin structure (SEM Image)

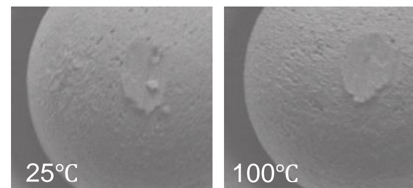


- Contact resistance



- ≤100mΩ, 100% Contact
- Individual Pin Force : 5.4gf/mil

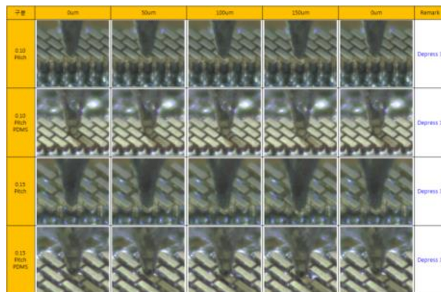
- Ball damage



Package	Flip Chip
Ball Size	Diameter : 80~85um Height : 75um
Material	Sn-2.5Ag lead free bump
Pin Force	20 gf
Test Temp	100 ºC / 25 ºC

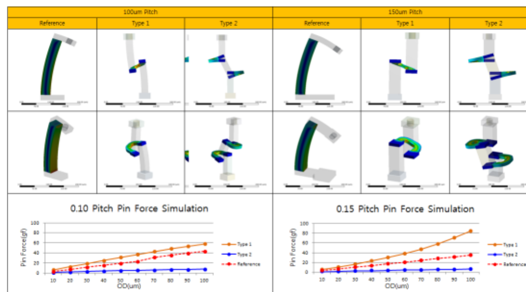
Experiment Results

- Pin force measurement



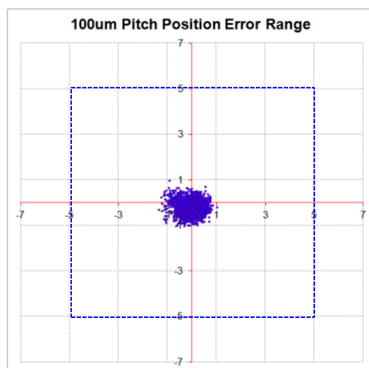
- 100 um Pitch Pin Force : 11.0 gF/mil
- 150 um Pitch Pin Force : 8.9 gF/mil

- Pin structure simulation

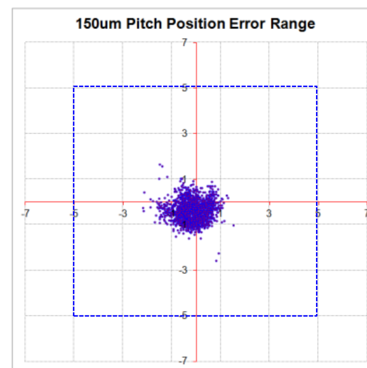


- 100 um Pitch New Pin Force : 2.0 gF/mil
- 150 um Pitch New Pin Force : 1.5 gF/mil

- Pin position



Min(um)	-1.3	-0.9
Max(um)	0.9	0.9
Range(um)	2.2	1.8



Min(um)	-2.1	-2.5
Max(um)	1.5	1.6
Range(um)	3.6	4.1

Summary

- We built up 100 um pitch 3D MEMS pin array on RDL structure and checked the possibility of capacitor SMT on the top side.
- The position accuracy of MEMS pin array is well controlled under ±2.5 um.
- Polyimide RDL structure has the 250 um pitch on PCB contact side and 100 & 150 um pitch on ball contact side.
- Contact resistance test demonstrated all contact under 100 mΩ in OD 100 um.
- Applying 20 gF/pin force causes smaller damage on the contact side of the ball compared to assembled type test socket.