

## **Low Temperature Flip-Chip Process using ICA and NCA (Isotropically and Non-Conductive Adhesive) for Flexible Displays Application**

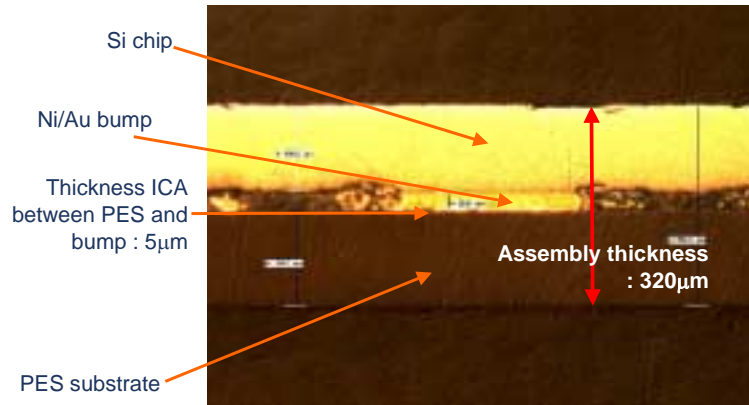
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In the smart card industry the trend exists to add functionality to the card. In the frame of the EC funded RTD project “CARBINE” [1] work is performed towards the integration of a flexible display into the smart card. As the display substrate material, PES (polyether sulphone) is used in a first approach because of its high thermal stability, but in a later stage it should be possible to use also cheaper materials like PET (polyester) with lower thermal and chemical stability. One of the options is to put the Si display driver chip on one of the display substrates using flip-chip technology. The main technological difficulties to overcome are the limited thickness of the assembly (max. 0.7mm for the entire smart card) and the temperature compatibility of the flip-chip assembly process with the display materials used (LCD, flexible display substrates). The consequence is that adhesive flip-chip technologies, conventionally used on glass display substrates, are not possible in this case, because they normally use anisotropic conductive adhesives (ACAs) with a curing temperature of 180°C minimum. Attempts are made, also within “CARBINE” to use anyhow suitable ACAs as the interconnection material, but at moment this technology exhibits specific difficulties like e.g. damage of the ITO transparent conductor on the flexible substrate, due to the thermocompression [2].

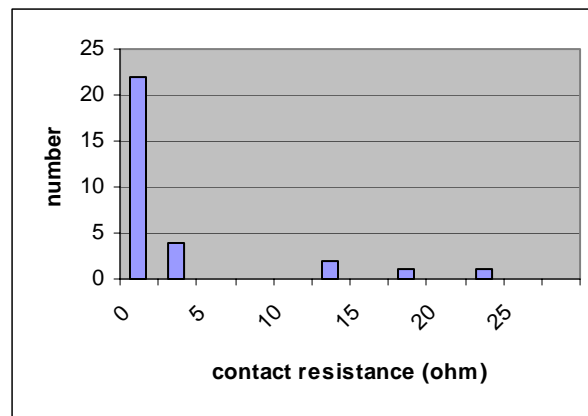
An alternative is to use isotropic conductive adhesive (ICA) as the interconnection material. Until recently ICA based flip-chip technologies were limited to small chips with large contact area and pitch. This is due to the occurrence of large mechanical stresses at the ICA joints during the conventional processing sequence where an underfill material is applied after curing of the ICA interconnection [3]. We have developed a new ICA/NCA flip-chip technology, based on the no-flow underfill soldered flip-chip technology [4], which eliminates the drawbacks of the conventional ICA flip-chip technology. This process is shown in the figure below. It consists of following steps :

- Application (e.g. stencil printing) and pre-curing (drying) of the ICA (a);
- Application of the NCA, e.g. by dispensing (b);
- Placement of the chip and thermocompression of the chip to the substrate (c).





Cross section of ICA/NCA assembly ; total assembly thickness = 320µm



Contact resistance distribution

The conclusion is that the developed ICA/NCA flip-chip technology forms a cost effective and feasible solution for the assembly of Si display drivers onto plastic PES substrates. It is expected that the technology can also be applied on cheap PET substrates.

- [1] Official CARBINE website : <http://www.nemoptic.com/carbine/index.htm>
- [2] K. Terashima, E. Tajima, Y. Hosaka, K. Ueda : “Study on Chip Mounting Technology for Plastic Film Liquid Crystal Displays”, 2002 ICEP Proceedings, pp. 290-294.
- [3] V. Pennanen, O. Rusanen : “Reliability testing on flip chip joining with isotropically conductive adhesives”, Proc. of the 11<sup>th</sup> European Microelectronics Conference – 1997, pp. 618-623; also in Journal of Electronics Manufacturing 7: (4) pp. 287-292, dec.97.
- [4] C.P. Wong, S.H. Shi, G. Jefferson : “High-Performance No-Flow Underfills for Low-Cost Flip-Chip Applications : Material Characterisation”, IEEE Trans. On CPMT – Part A, Vol.21, No. 3, Sept. '98, pp. 450-458.