Non Destructive Die Reclamation and Reassembly

Force are now adding Die Reclamation to their extensive list of processes. Die Reclamation is the process in which die is removed from a plastic or ceramic package without damaging the Die itself. This die can then be reassembled into ANY available ceramic or plastic package.

This approach greatly increases product survivability allowing avaliable plastic parts to be used in rugged and/or high temperature applications that require ceramic packages. Although some packages prove more taxing to work with, Force has yet to encounter a plastic or ceramic package in which we were unable to remove the die from without damage.

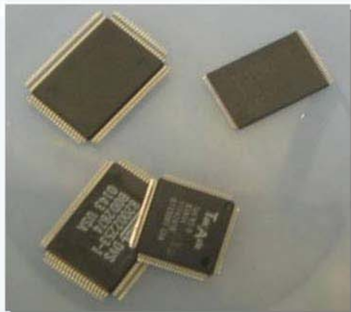
Solutions

- Move die from plastic packages to rugged ceramic packages
- Reassemble previously removed die into any available package plastic or ceramic
- Create Multi Chip Modules (MCM) from packaged ICs
- Die Removal Process does NOT induce damage to the die
- Locate Counterfeit circuitry in Die for Intellectual Property (IP) Verification and Litigation

Benefits

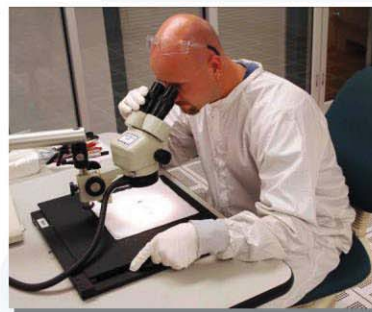
- Greatly improved reliability - die can be removed from plastic packages and reassembled into rugged ceramic packages providing far greater reliability
- Meet customer requirements - provide a customer with an obsolete IC in the package they NEED, not just the package in inventory
- Faster Turn around times - same day turns avaliable
- Save Money - by not requiring large die lots for Prototype development
- Cost Effective
- Force can extract die from ANY package and reassemble those die into ANY other available package

Die Extraction Process



Force Will decap the package and safetly extract the dice for repackaging or MCMs

Performing the etch and die removal process



Apprasing etch process to assure product quality

Extracted dice from original packaging ready to ship or ready for reassembly

The die extraction process relies on chemical and mechanical process no more aggressive than those with which the original die was exposed during manufacture.

Once the die has been successfully harvested the original gold wires are mechanically removed just above the original gold ball bond, providing a clean, uncontaminated gold surface for high-adhesion re-bonding. The only subsequent non-standard assembly process is that a new gold ball bond is made to the existing gold ball bond surface, rather than to the original aluminum pad interface.

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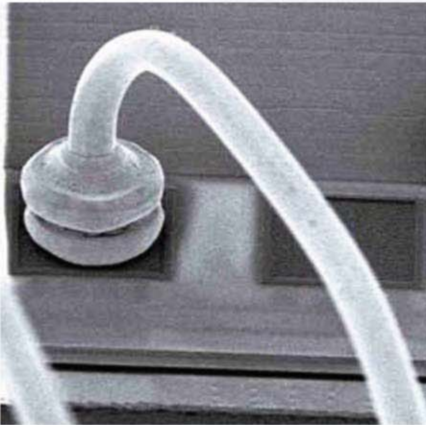
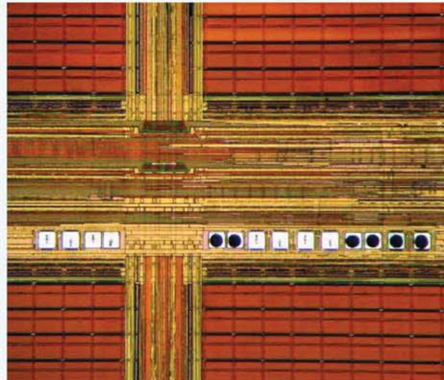
Die Extraction Process (Cont)

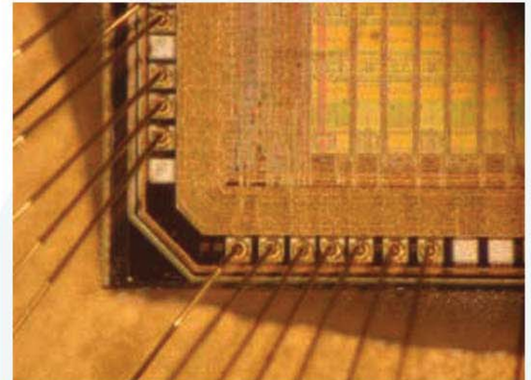
Under proper process optimisation, the new gold bond on the existing gold ball bond adheres extremely well. This statement can be supported with pre and post die extraction/re-assembly bond pull data which is not only indistinguishable in both cases, but also generally limited to the tensile strength of the bond wire used. Additional test data referencing die shear and bond shear is also statistically identical for pre and post extraction/re-assembly processing. Lastly, the extraction and re-assembly processing can be shown to have the added benefit of providing inspected, genuine silicon for subsequent re-assembly, while significantly reducing the possibility of inadvertent use of counterfeit devices in military systems.



The original bond pads are left on the die. New gold bond pad adheres extremely well. A bond pull test typically exceeds the 3 oz required by



Close up view showing post-etch die integrity after die is removed from package.



Example of extracted die installed in a ceramic package

Qualification

To ensure the highest level of assurance side-by-side accelerated life tests were performed, collecting data at 250C using the same silicon dice packaged in plastic ICs vs those packaged in ceramic ICs. The ceramic ICs contained dice that were removed from the same lot as the plastic ICs and were selected using a random sample.

Every pin is periodically tested for continuity at periodic readpoints after exposure to 250C, the results showed the plastic packaged die began to fail showing "opens" after only 81 hours at 250C (which is equivalent to 350 hours at 185C) while the same die reassembled into ceramic packages began to show "opens" only after more than 1000 hours at 250C (which is equivalent to 16,000 hours at 185C). This data clearly demonstrates that the lifetime of the repackaged ceramic ICs was increased by more than 10X over the lifetimes of the plastic ICs at high temperatures.

Examples How Force Die Removal and Reassembly Services Save Time and Money:

Example #1 - *A customer's high-temperature, rugged application requires ICs packaged in ceramic packages but the needed ICs are only commercially available in plastic packages. Force will extract the die from the plastic packages and re-assemble those die into rugged ceramic packages. This typically increases survivability by more than 10X in rugged, high- temperature environments.*

Example #2 - *A customer wants to build a few hundred engineering samples in a specific package, a flip-chip assembly or a multi-chip module (MCM) but cannot purchase die in quantities smaller than 10,000 units. However, small quantities of packaged units in an unwanted plastic package are immediately available. Force will extract the die from these packages and reassemble them into the desired packages or supply "bare die" for an MCM application as desired.*

Example #3 - *A customer urgently requires a die in a package that is not readily available. Die removal and reassembly provides a viable option to waiting several weeks or indefinitely for additional silicon from a fab or foundry. If the die is available in ANY package, Force can expedite a die removal order and ship the bare dice to the desired location or re-assemble into the desired package avoiding delay.*

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