Sealant/caulk material aids decapsulation of electronic components

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Most failure analysis labs are challenged by new problems and existing equipment. Old techniques must be modified to be effective on new technology. EDFA readers are encouraged to submit examples of master FA techniques for future publication.

ENGINEERING research company ACI Technologies is tasked with decapsulation of electronics components for testing and investigative purposes. In the normal method of decapsulation, an analyst uses a rotary tool to drill a small indentation in the hermetic sealant material and then applies nitric acid to eat through the polymeric encapsulant.

The company performs this decapsulation for a number of purposes, including wire bond inspection, operational testing, and counterfeit investigation. This testing method allows the operator to explore a silicon die while it is still on a functioning board. Typical pieces being tested are 5 x 5 mm in size.

THE PROBLEM

In the traditional method of decapsulation, the operator makes a small well above the location of the die and places the component in a tin tray on top of a 140 °C hot plate. The operator adds nitric acid in a dropwise fashion into the well to allow digestion of the packaging material.

Two identical (side-by-side) components with caulk well on the left and carved well on the right.

Photo courtesy of ACI Technologies
After 10 to 30 s, the acid is rinsed with acetone for neutralization. The process is repeated until the die and wire bonds of the package are exposed.

While the rotary-tool method is the standard practice, it does have some drawbacks:

- The drilling process introduces an outside source of disruption to the device.
- The drilled well still allows the nitric acid to flow from the surface of the encapsulant.
- It is difficult to direct where the acid is working on the encapsulant.

**THE SOLUTION**

Faced with the shortcomings of the current process, the company set out to find a better solution. They discovered that Texas Instruments had successfully used a 2078 Viton Caulk from Pelseal Technologies to assist with decapsulation. This caulk exhibits strong chemical properties and remains flexible in service. The company decided to adopt this approach by using the caulk to build up a well to contain the nitric acid, rather than drilling into the component.[1]

To form the well, ACI built up approximately 2 to 4 g of caulk above the die location (in place of carving out a small well) and placed the component on the hot plate. When the component reached the correct temperature, the operator dropped nitric acid into the fabricated well to allow digestion of the packaging material. This was then rinsed with acetone, and the process was repeated until the die was exposed.

After using the caulk-constructed well method of decapsulation, the company found:

- By not drilling directly into the surface of the die, no additional mechanical damage was introduced.
- Electrostatic discharge/electrical overstress was removed from the equation, thus increasing the confidence in the results.
- The caulk adheres easily to a wide range of component materials.
- The caulk was easily removed after decapsulation by simply tugging on it with a pair of tweezers. (The caulk stood up to repeated acetone rinse steps.)
- The deposition of the caulk permits outlining of various geometries, making it possible to use it with a wide range of die sizes and shapes.
- Safety is increased by creating a well on the surface of the die that stands above the original topography, eliminating any splashing or accidental misuse of concentrated acids.
- A larger quantity of acid could be used in the caulk-constructed well, resulting in less time needed for the decapsulation process.

After determining that the use of a caulk well made the decapsulation process easier and more effective, the engineering research company decided to continue using the caulk, and they plan to integrate it into their standard decapsulation procedures.

**REFERENCE**