Hybrids, Power Devices and Multi-Chip Modules

Application Overview:

Due to SAMs superior ability of detect very thin air gaps and ability to easy penetrate dense metallic materials, acoustic inspection of hybrids is a dominant failure analysis technique. Inadequate heat dissipation is one of the more common reasons of field-failure of hybrid and MCM devices. Many manufacturers have felt the need to qualify their solder material and deposition process using SAM equipment in a process control role. Helium leak tests are a common method of determining lid seal quality, but acoustics has the ability to find areas were the lid seal is compromised or may become comprised down the road in the lifetime of the device.

Package Types:

MCMs, Power PAK, hybrids

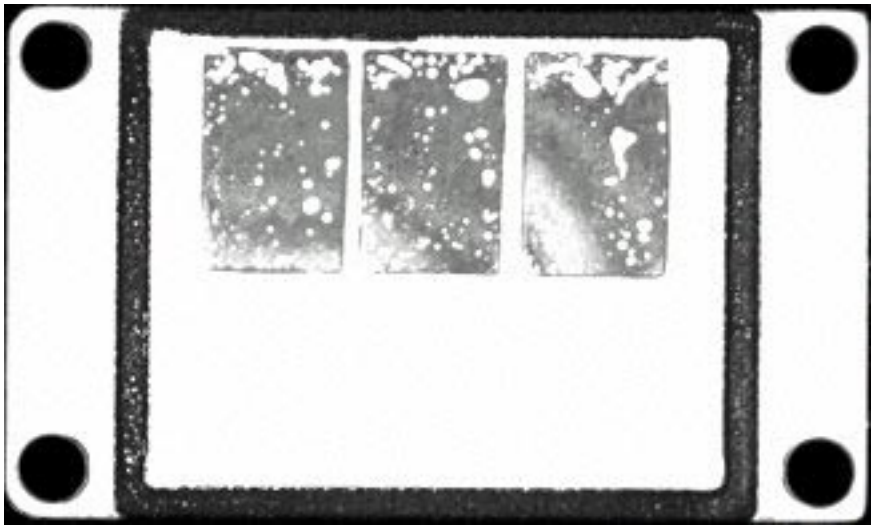
Inspection Standards:

- none -

Failure Types Commonly Detected:

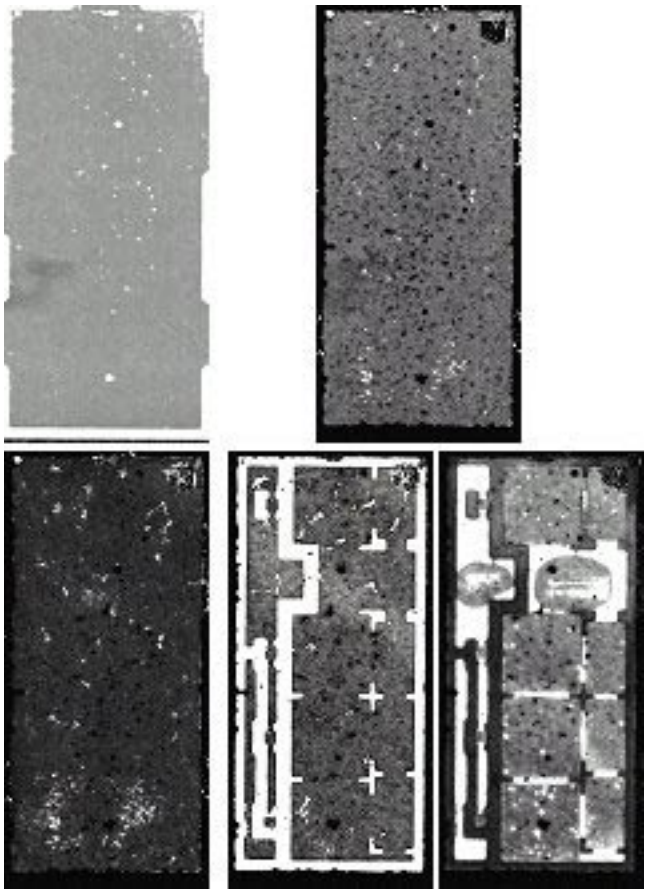
Heat sink solder bond integrity
Substrate bond integrity
Die bond integrity
Lid seal bond quality
Die cracks
Insufficient solder material
Excessive solder reflow
Seal integrity

Images:



This is a pulse-echo (reflected) mode image of bond quality between a solder pre-form pre-preg and a copper-tungsten base plate. Voiding in the solder bond can be seen. Studies have shown that die temperature becomes critically high when solder layers become greater than 25% disbonded. In addition, disbonds and voids have been shown to expand upon stressing, thereby affecting long term reliability. A void in the lid seal can also be seen in this device. If the void propagates across the entire lid seal, the hermetic nature of the device is destroyed. Typically, leak tests can determine if the seal has been compromised, however acoustics has the ability to find voids that don't quite open the seal, but upon thermal stressing can later cause failure.

This is a pulse-echo (reflected) mode image of bond quality between a die and the substrate. Voiding in the solder bond can be seen as white in this image. This device also suffers from insufficient solder coverage over the intended bond area. This lack of coverage will cause the die to heat up to untolerable levels, causing future device failure.



This is a TAMI™ Scan pulse-echo image of a series of layers within a molybdenum (moly) hybrid device. All five of the images shown here were taken in a single scan in less than 5 minutes. The upper left image is of the moly to solder interface. White areas signify voids that were trapped between the heat sink and the solder during the vacuum deposition process. The image in the upper right is within the solder layer. The lower left image is at a layer even deeper within the solder. Again, bright white areas signify voids within the solder. Research has shown that voids within the solder layer are not as critical as voids right at a bond interface as a result of the reduced bonding surface area interface voids create. The lower middle image is from the solder to substrate interface. The lower right image is the die attach interface. Likewise, bright white areas are voids between the bonding layers.