Notes from Ken Gilleo, 7/22/09

More and more articles and papers are being written about MEMS but without adding anything that is substantially new. The redundant theme is, *"MEMS is the bright spot in the recession"*. The subject of MEMS packaging is usually mentioned, but with no specifics. Some of us mentioned, about 10 years ago, that MEMS packaging was a big challenge and most writers pick up on that, but as WLP techniques progress, this is less true. I now think that 3D stacked is more challenging than MEMS, with the exception of advanced bio-MEMS requiring fluidic coupling that is still a ways off.

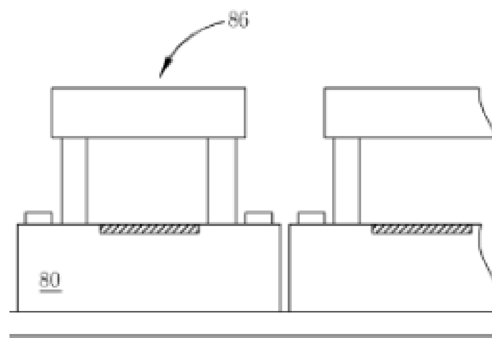
Research institutes seem to have focused on process improvement of specific steps for existing packaging concepts; e.g.; laser assisted wafer bonding.

While WLP is touted as the new package for MEMS, there is little new being disclosed, and not even in patents. Articles have almost no specifics. Ironically, the old ceramic cavity packages remain the safe, proven and popular solution. The popular ceramic QFN is the rather ancient LCCC (leadless ceramic chip carrier); it's now smaller and cheaper, but still decades old.

Chip scale and wafer-level are always "ready for adoption" by the MEMS industry, but this seems to be taking a long time. A small number of dedicated MEMS packaging vendors are still around, like Hymite and Silex, but are struggling, even before the recession. Quantum Leap Packaging went bankrupt a few months ago, and assets were sold (molding machines reportedly purchased by Interplex in Rhode Island). Mirror Semiconductor (Marty Hart) is open for business with LCP molded cavity packages, but time will tell if they are viable. Marty is a smart guy, so he has a reasonable chance of success – unless injection molded plastic really is a bad idea.

In terms of "newer" MEMS packages, there are 3 basic designs appearing in the latest patent applications, but they are the same that have been known for a decade, making them "improvements" rather than "pioneering. The old wafer-level capping, introduced by Analog Devices and used for many accelerometers, is still being pursued, but it is a pre-packaging method that requires traditional packaging: die bond the capped chip, wire bond, then overmold.

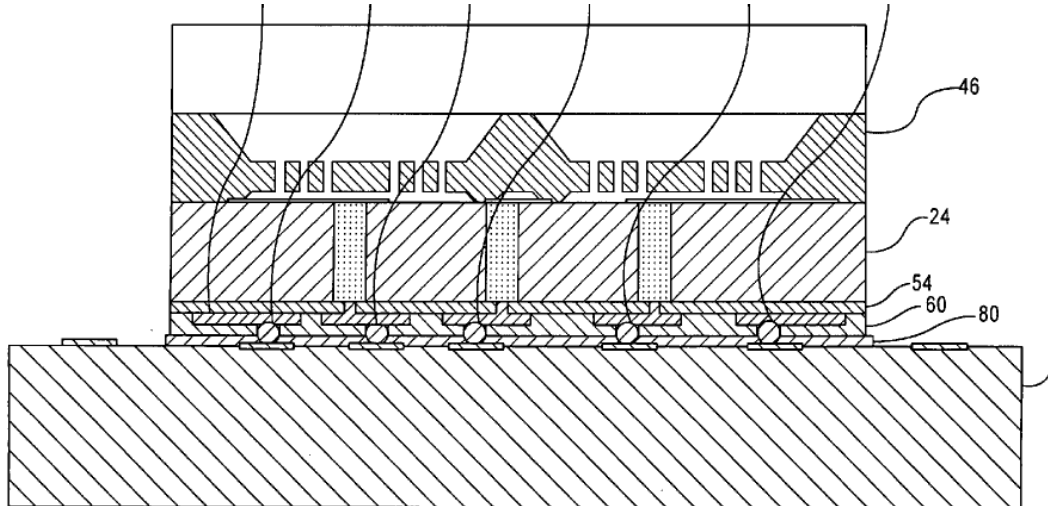
Figure from US application **20070161210 filed in 2007:**



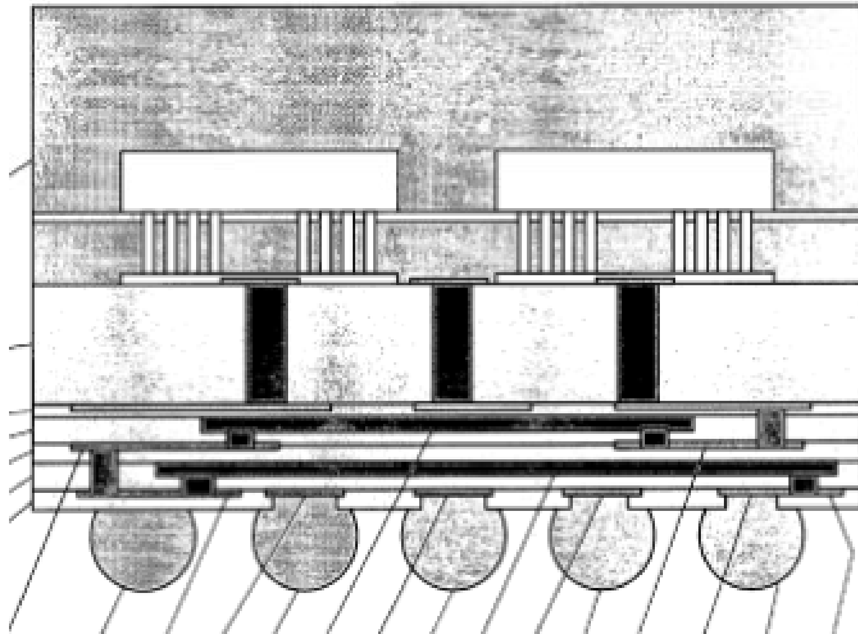
This idea is more than a decade old and needs to be replaced by WLP. It's really only viable for totally enclosable MEMS – accelerometers and gyroscopes. That brings us to WLP where there are two basic ideas. Create TSVs in cap, or in MEMS wafer. TSV in cap seems simpler and safer, but many seem to like TSV in MEMS. Here are some of the recent US patent applications.

WLP TSV through MEMS (disclaimer – I went through these without reading details, so I could have got some of them wrong).

US patent application 20090137079, VTI in Finland:



Another from Finland, not assigned, but probably VTI:

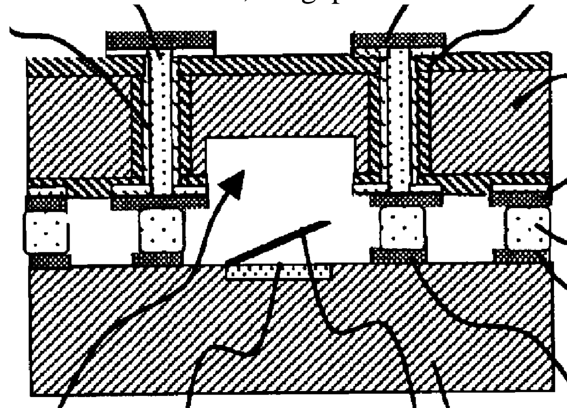


US application 20080122055 from Micron:

US Application 20080136009 unassigned, from Germany:

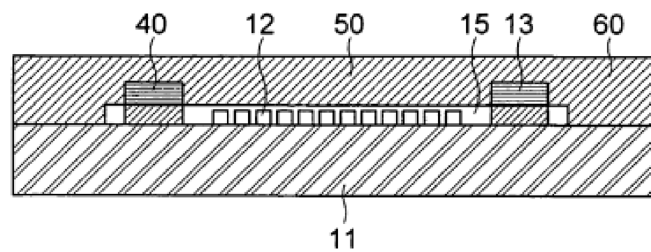
<u>WLP TSV through cap</u>

US patent 6,846,725 to Inst. of Electronics, Singapore

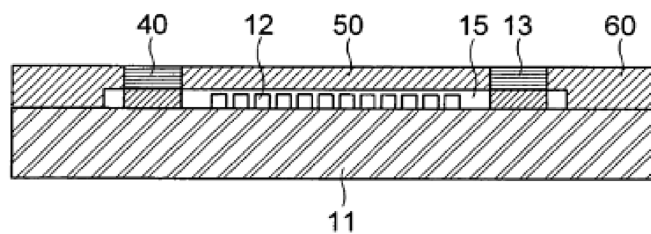


US Appl **20090085204 assigned to Samsung:**

[FIG. 20]



[FIG. 21]



US 20060216857, probably Analog Devices: