"Advanced MEMS Packaging"

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Advanced MEMS packaging is perhaps the most difficult technical challenge facing the electronics industry. It combines some of the still-unsolved riddles of 3D packaging with the difficulties of hermetic cavity packaging and the demands of non-electronic signal sensing.

In contrast to integrated circuit packaging, MEMS (Micro Electro-Mechanical Systems) require the physical motion of essential mechanical elements. Mechanical motion requires a cavity package, rather than a molded solid one. Advanced applications such as biosensors require conveying non-electrical stimuli into the device. Efficient use of space requires 3-dimensional assembly.

Consequently, advanced MEMS packaging is more complicated and costly than IC packaging. Cavities containing free-standing microstructures with moveable elements must be suitably protective while allowing interaction of the microstructure with the surrounding environment. Wafer-level 3D thin packaging is preferred to meet space and cost constraints.

Present MEMS package cost is typically 50% to 80% of the total cost of the finished device. Major challenges in cost, yield, and reliability for volume production remain to be solved. "Advanced MEMS Packaging" is a guidebook for solving them.

This 550-page book is an exhaustive examination of the current state of leading-edge MEMS packaging, the major directions that are being followed, and the research that might lead to solutions. A business-oriented introduction, including 37 pages listing MEMS patents since 2001, shows the book's practical viewpoint. An overview chapter describes the present state of advanced IC packaging, with potential applications to MEMS.

The two following chapters review the enabling technologies needed to address the challenges, including through-silicon vias, wafer thinning and handling, chip-to-chip, chip-to-wafer, and wafer-to-wafer bonding. Advanced MEMS packaging will generally combine three wafers: the MEMS, an integrated circuit, and a cavity cap. Two case studies on low-temperature solder assembly show the balancing silver and indium required for eutectic and non-eutectic In/Ag soldering in assembly.

Applications chapters follow. Optical MEMS applications include communications, bubble switches, and microbolometers. Case studies are included for variable optical attenuators and for optical switches. Appendices for bubble switches cover interferometry and finite element analysis. Bio-MEMS applications include micro-fluidics and biosensors. Accelerometer chapters include three possible process flows. Three closing chapters deal with RF MEMS, including switches and filters.

In summary, this book offers a good mix of background, theory, practice, and projection. It should be a valuable aid for anyone associated with or considering advanced MEMS research, production, or use.

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