boschman

SALLAND Engineering
Test Technology Center

Salland Engineering MEMS seminar: Molded packaging solutions for MEMS & Sensors.

Marco Koelink, June 2019

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I. Introduction

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package development by boschman

assembly services by boschman

equipment by boschman

Package Development:

We research, design and prototype advanced packaging concepts. Together with our customers we develop and assemble innovative, out of the box package solutions.

Typically there are 3 phases: Package conceptualization, Package design and Package Prototyping & & delivery of engineering samples for full qualification.

Assembly Services:

We can manufacture low to medium volume quantities of your qualified products using semi-or fully automatic processes. We offer our assembly services as a separate service or in combination with other services as part of the cycle 'from idea to production'.

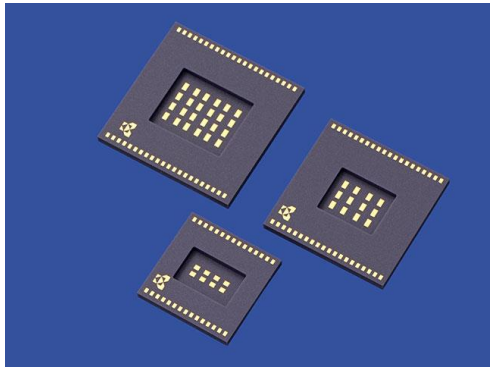
Equipment:

Boschman specializes in the development and supply of advanced transfer molding and sintering systems for electronic assembly industries across the globe. We offer added-value encapsulation and bonding process and equipment solutions for a wide range of packages.

II. Types of packages

There are a multitude of package solutions available for MEMS and Sensors:

- Metal (hermetic) packages
- Ceramic (hermetic) packages
- Transfer-molded packages



II. Types of packages

Why would you use transfer molded packages?

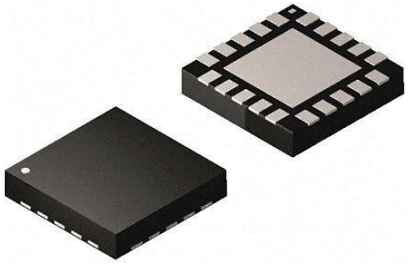
- the most frequently used packaging technologies in the semiconductor industry (1960's)
- fast process time
- exact mechanical dimensions that can be achieved
- uniform density of the package and repeatability
- low-cost/high-volume mix that can be achieved

Only draw-back: temp limited (~220 C) and not hermetic!

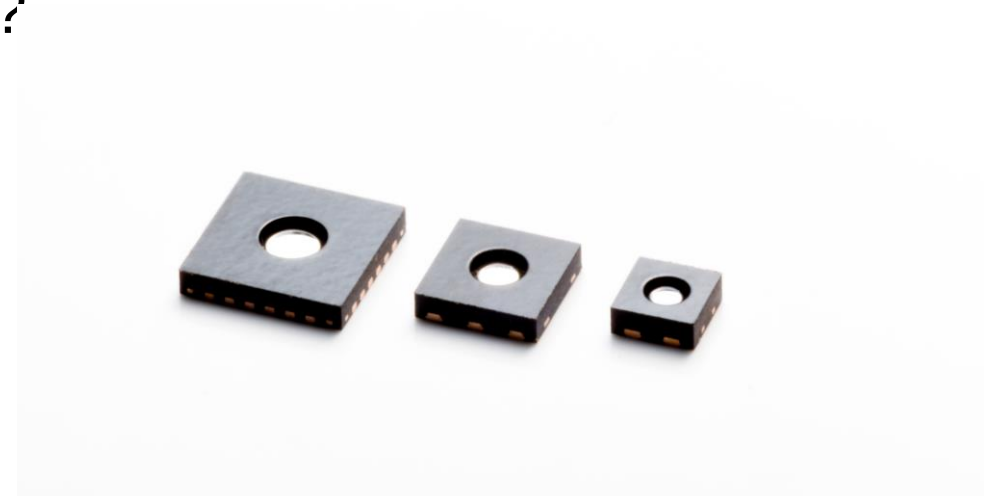
MSL-3 typical, MSL-2 possible, MSL-1 very hard

II. Types of packages

How many different (molded) types are there?



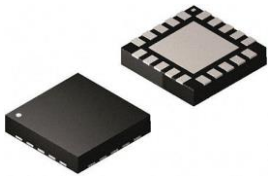
Fully encapsulated



Partially exposed

II. Types of packages

How many different (molded) types are there?

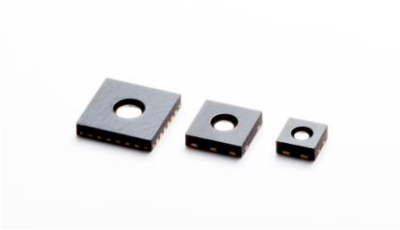


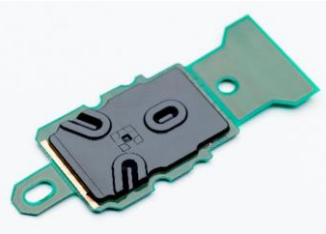
QFN

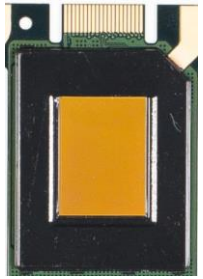
SO

TO

Industry Standard







Customized

III. Application areas

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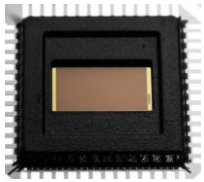
Optical/ Photonic sensors

Flow/ Humidity sensors

Automotive pressure sensors

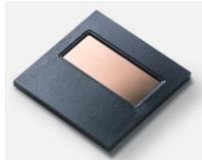
Camera sensors



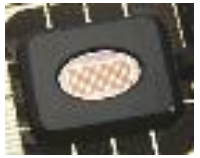
CPV (Solar cells)

Temp sensors

DNA sensors



Bio-sensors

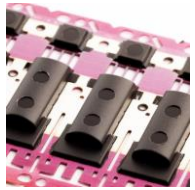


RF sensors

Fingerprint sensors

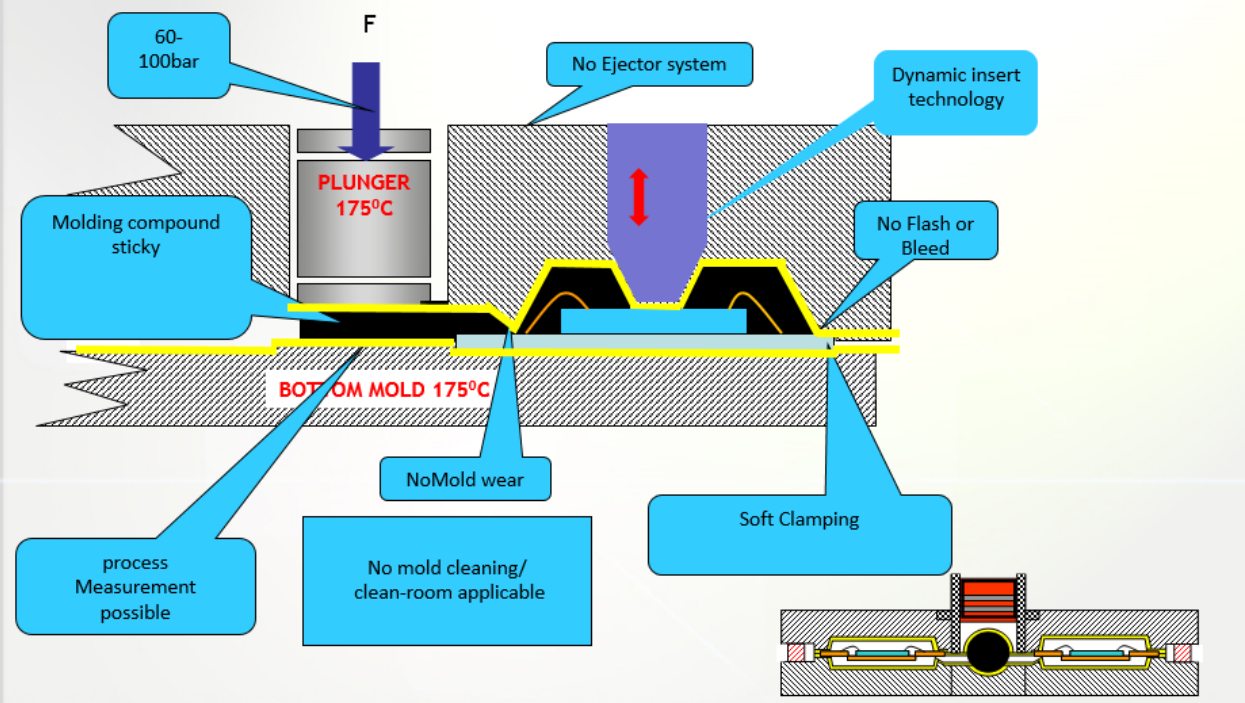
Gas sensors

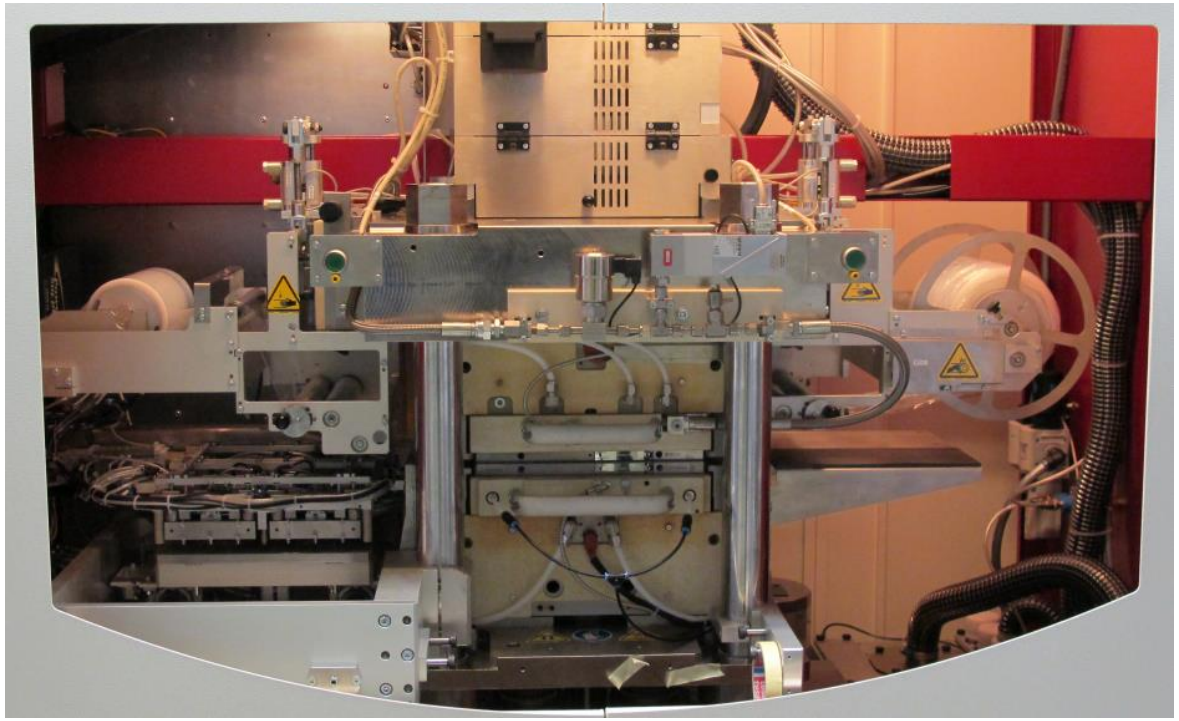
Current (Hall) sensors



IV. Molding technology

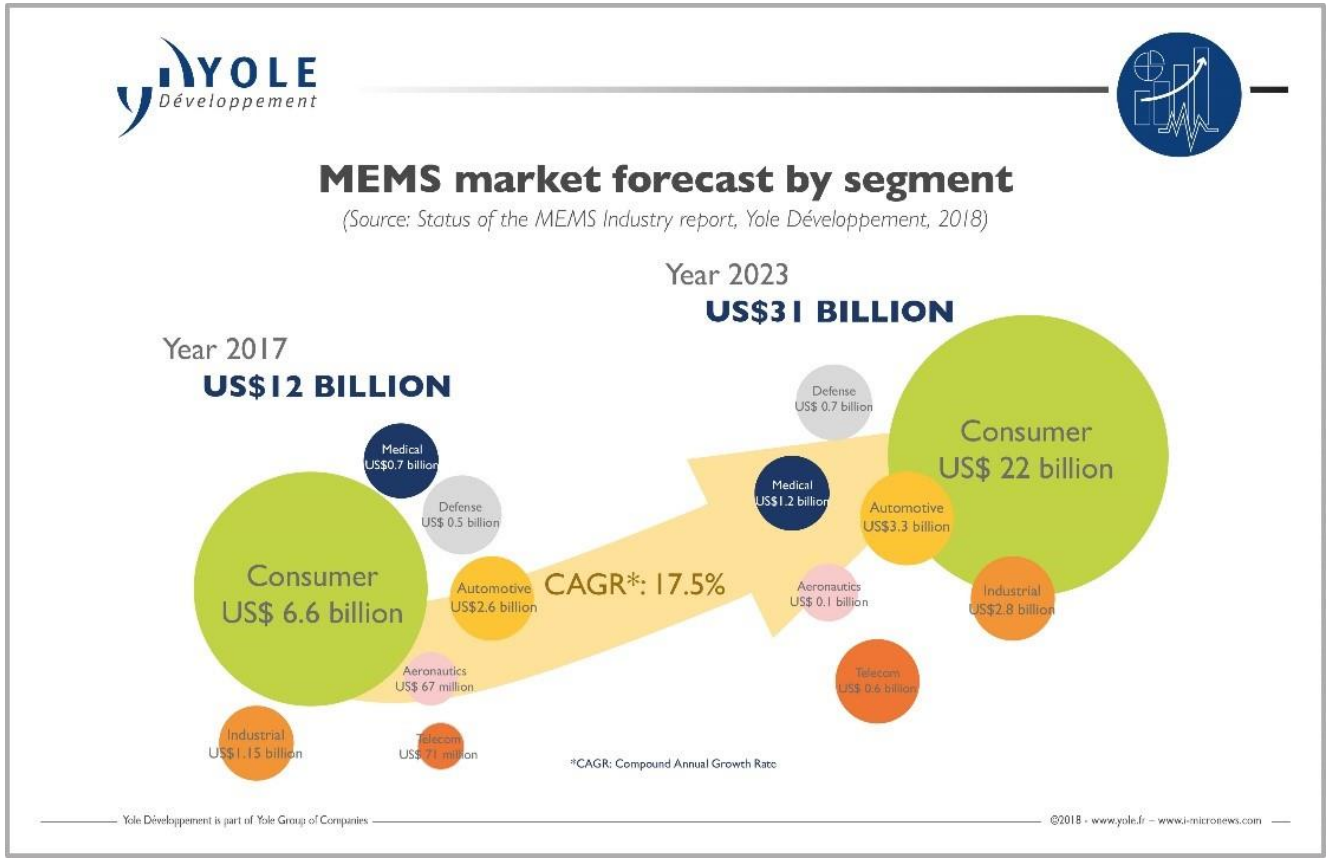
Creating exposed areas





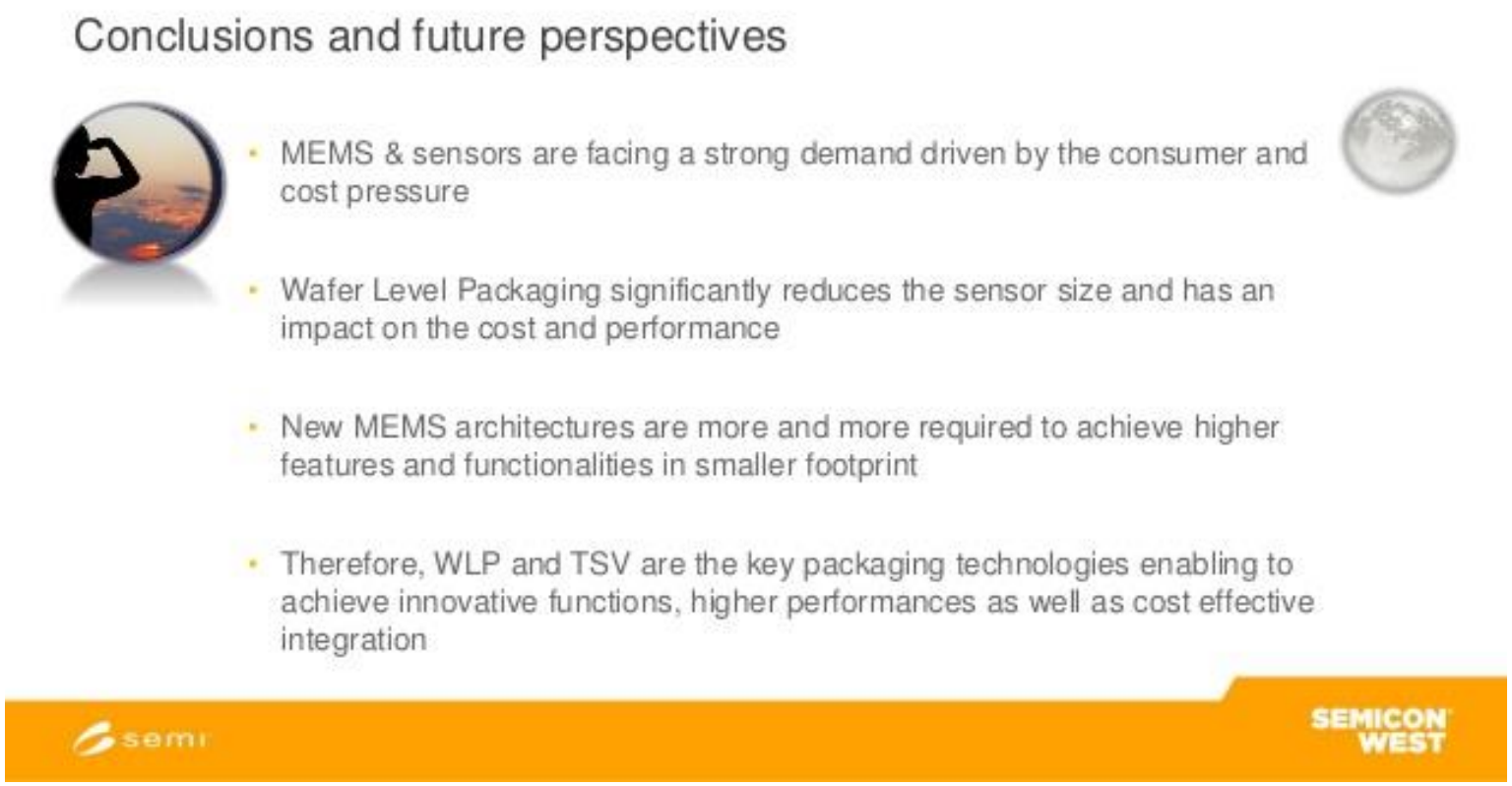
V. Developments

Growth!



V. Developments

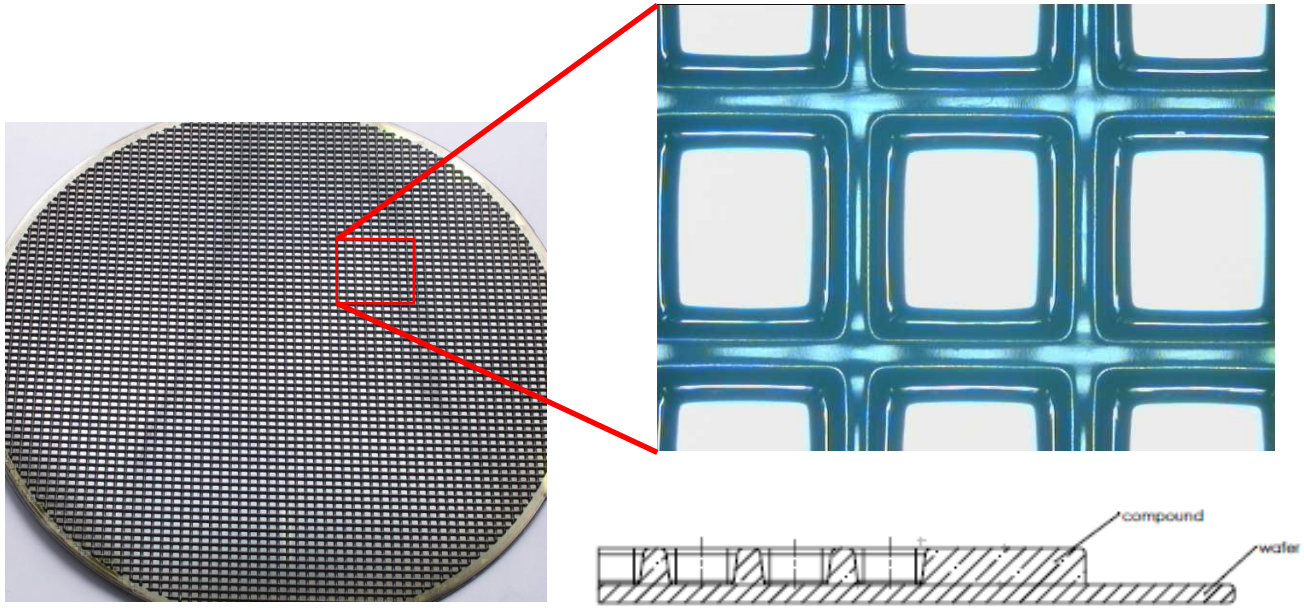
Smaller and smarter!

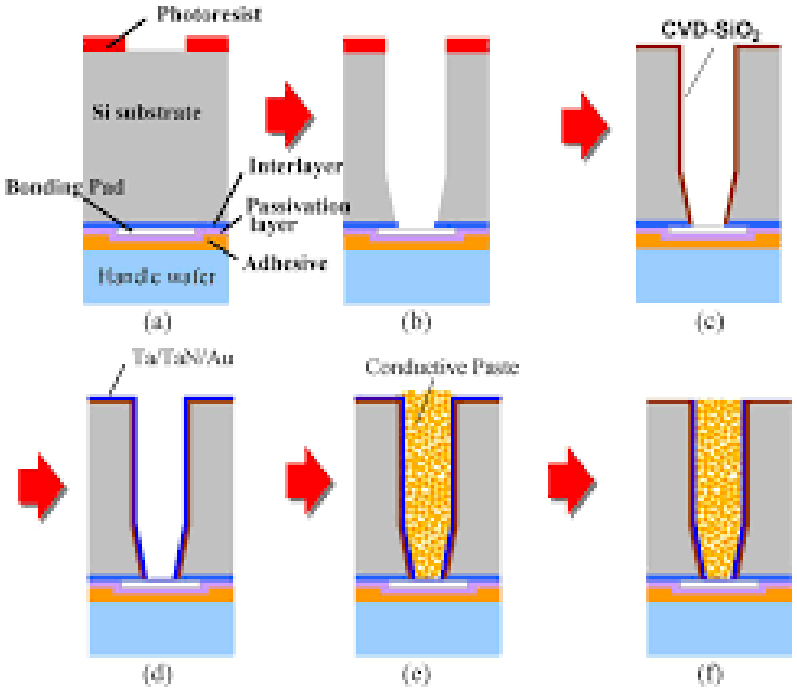


Amandine Pizzagalli on Semicon West 2016 by Yole Développement

V. Developments

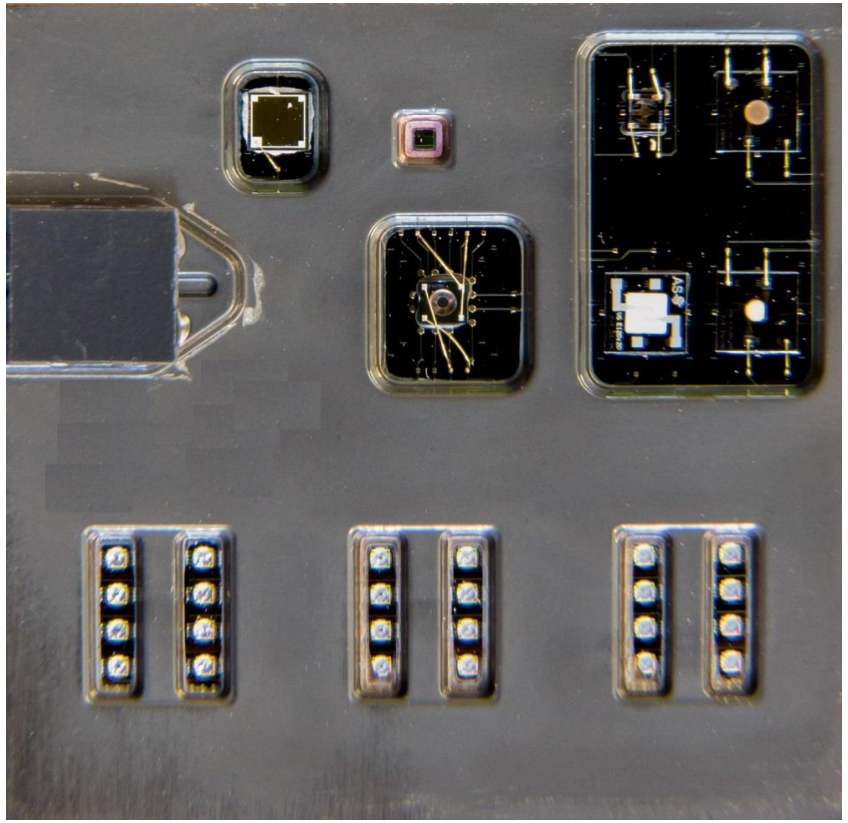
WLP and TSV





V. Developments

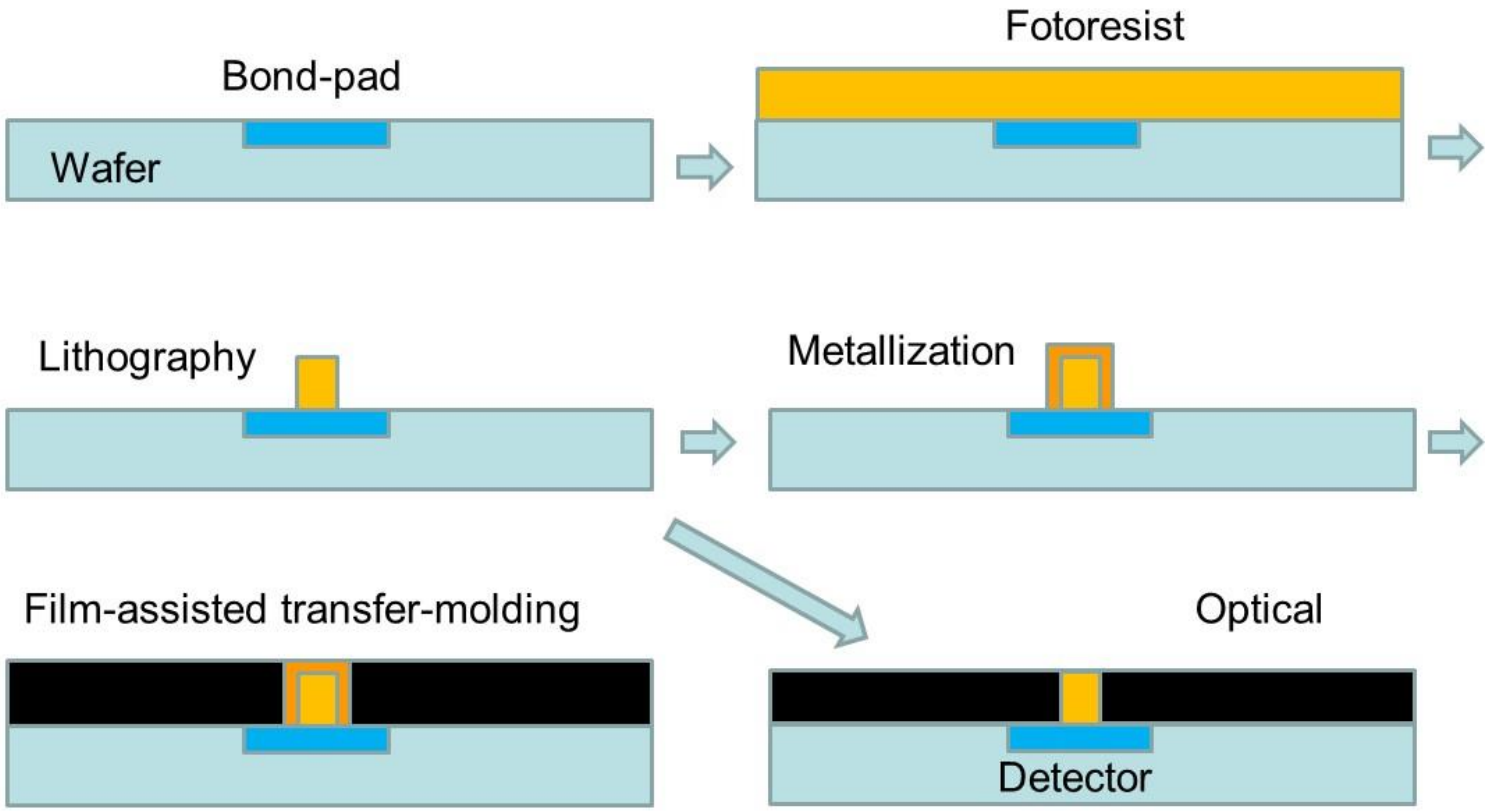
Example



Multi-sensor package with 27 sensor elements, temperature sensors, moisture sensors, different gas sensors (CO, CO2, O3, NO2 and VOC) and optical sensing elements (UV, VIS and IR). Device is integrated on a smart silicon substrate with Through-Silicon-Via technology using a low-warpage molding compound.

V. Developments

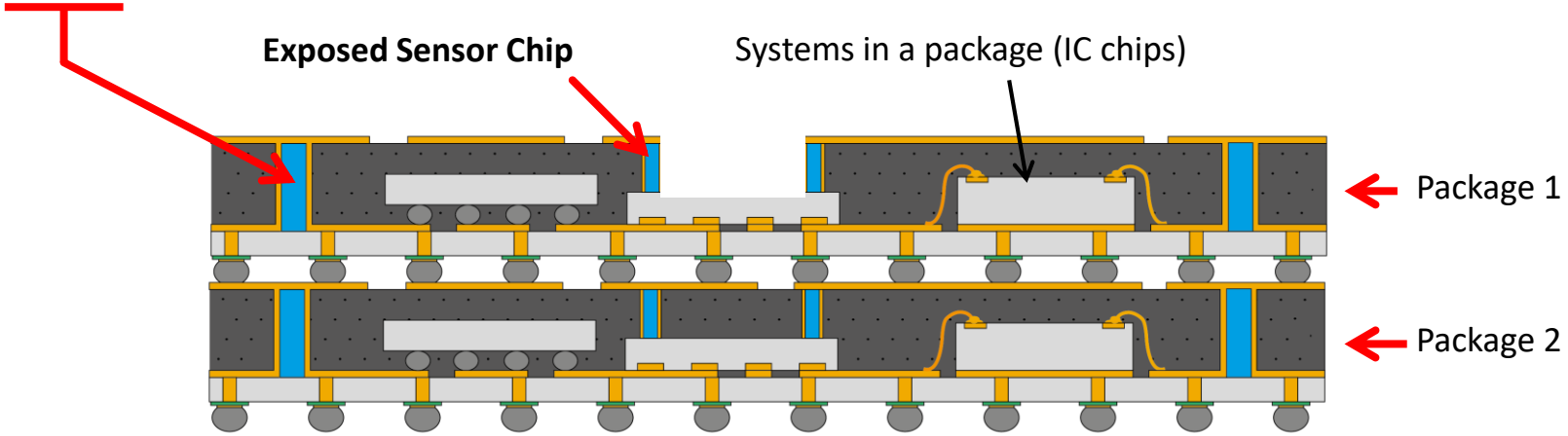
Through Polymer Via: alternative for TSV



V. Developments

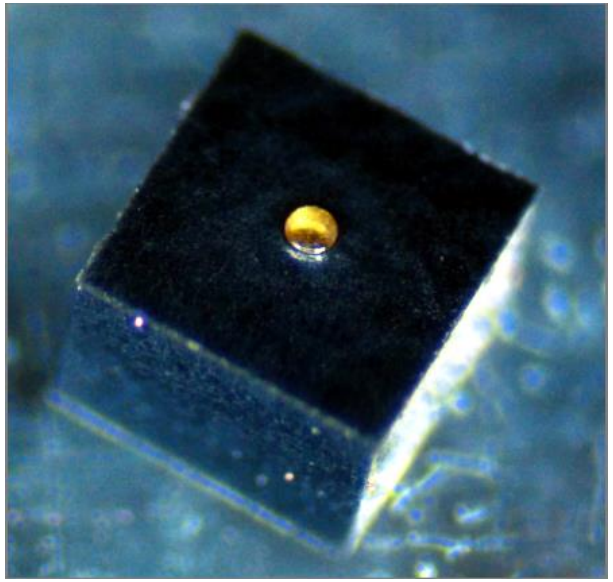
Through Polymer Via: alternative for TSV

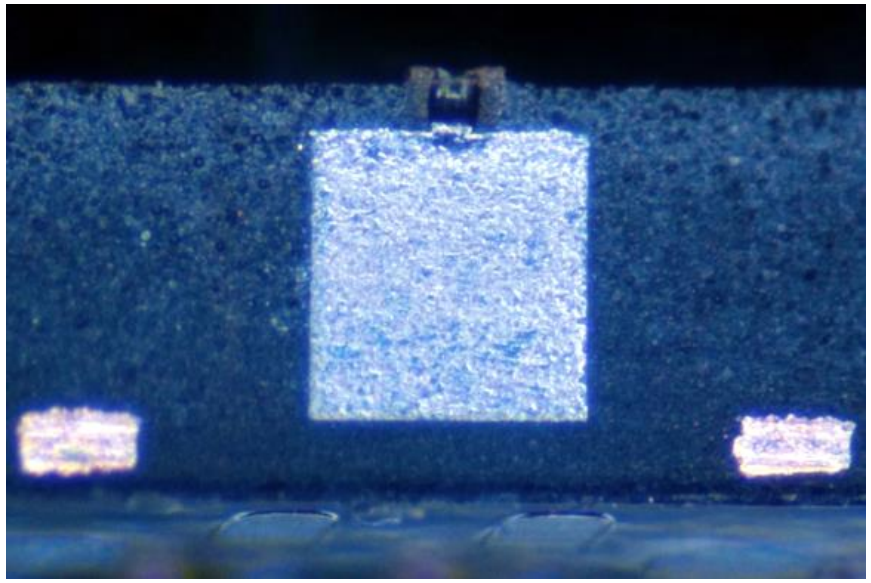
- Novel and robust approaches for fabrication of vertical through package interconnects: 3D stacking
  - Connect chips, devices, wafers, microfluidics etc. in out-of-plane direction
- Create steep and/or small windows for MEMS and sensors



V. Developments

Example



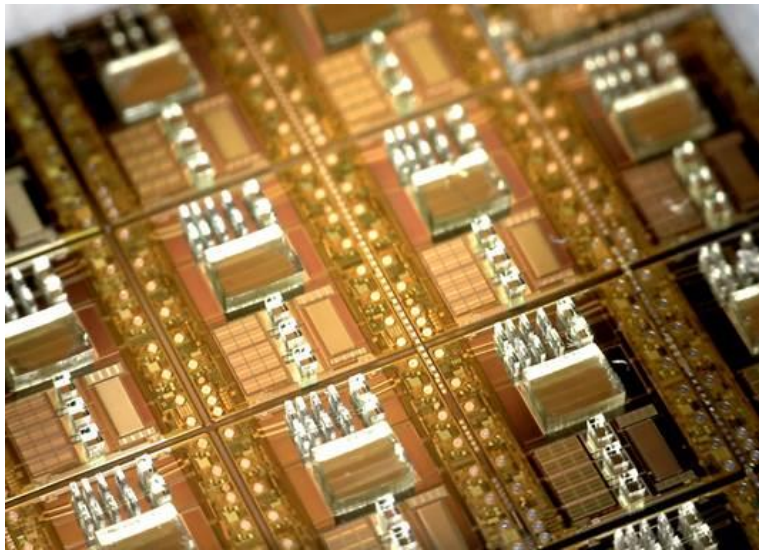


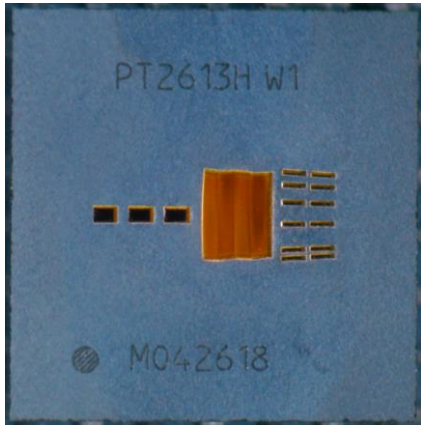
1x1 QFN sensor package with 100 mu exposed window.

Smallest sensor package in the world?

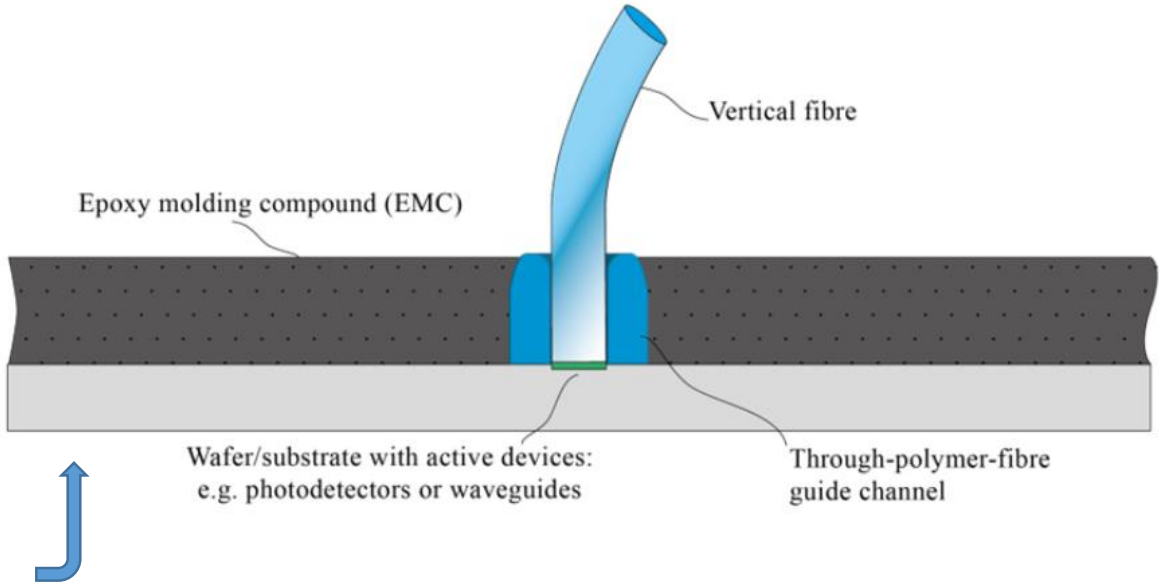
V. Developments

Through Polymer Via: alternative for TSV





Optical solutions



Mechanical solutions

V. Developments

(3D) Printing in front- and back-end

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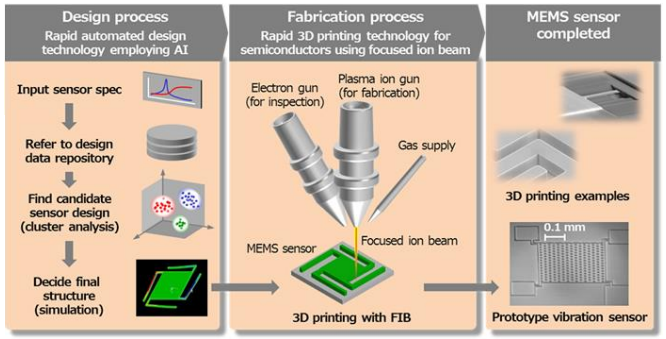


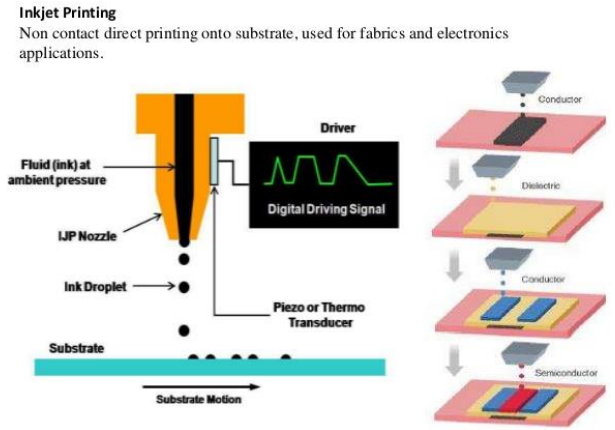
sensors

MDPI

Review

The Boom in 3D-Printed Sensor Technology

Yuanyuan Xu [1,†], Xiaoyue Wu [2,†], Xiao Guo [2,†], Bin Kong [1], Min Zhang [2], Xiang Qian [2], Shengli Mi [2,3,*] and Wei Sun [1,2,4,5,*]



Additive / Subtractive

Mask / Mask-less

VI. Conclusions

Summary

- The market for MEMS and Sensors is expected to grow significantly
- Cost pressure favors transfer-molded packaging solutions
- Transfer-molded packages are limited in hermeticity and temperature
- Technical developments focus on smaller (~lower cost) and smarter (more integrated) solutions
- Although there is a significant growth in this market segment, the large variation of package-outlines limits the economy-of-scale.
- With growth more standardization is necessary to achieve a next cost-down step.

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