3D-MID
Coming from prototypes to production

SMT/Hybrid/Packaging 2014

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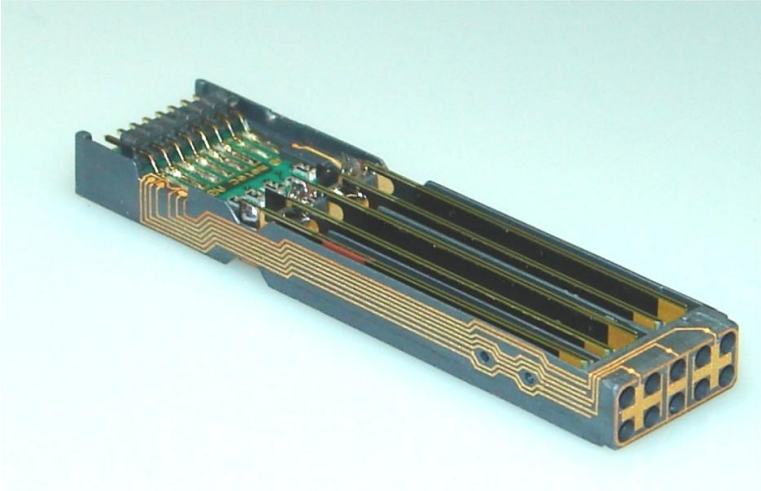
Outline

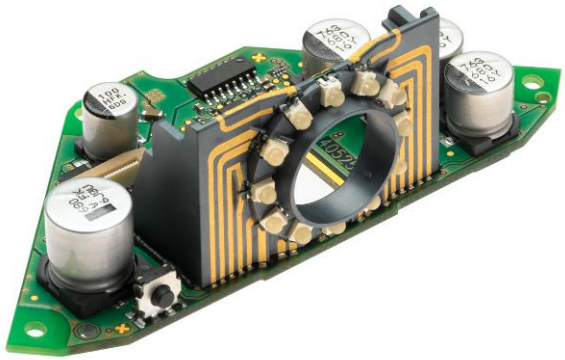
- Introduction to MID
- Competences of HSG-IMAT
- Current research activities at HSG-IMAT
- Development of MID devices at HSG-IMAT
- Prototyping of MID & 3W-MID

3D-MID Technology

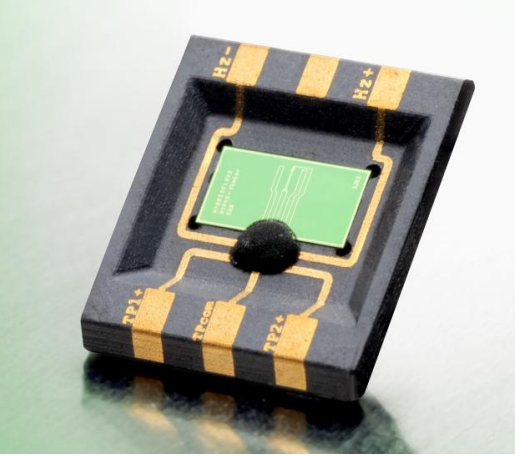
Quelle: Robert Bosch GmbH



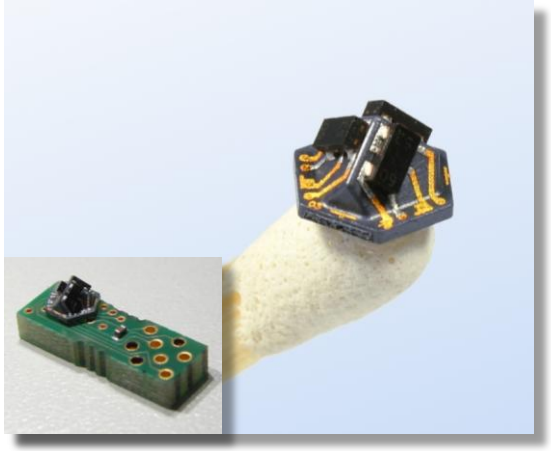
Quelle: METEC AG & HSG-IMAT



Quelle: Harting AG Mitronics & Sick AG



Quelle: 2E mechatronic GmbH



IGF Vorhaben 17163 N: ADIMA-3D

Quelle: LPKF AG

HSG-IMAT and IFM

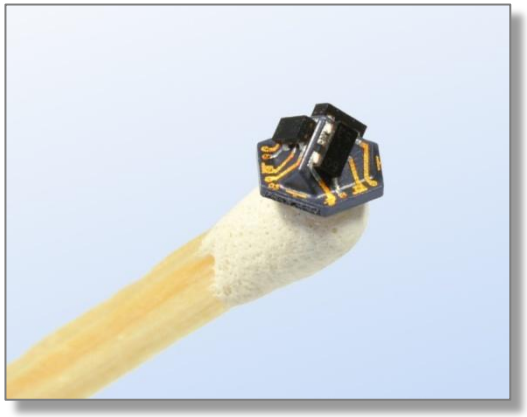
Institute for Micro Assembly Technology
45 Staff Members
www.hsg-imat.de
Director: Prof. H. Kück

Institute for Microintegration, Stuttgart University
12 Staff Members
www.uni-stuttgart.de/izfm
Director: Prof. H. Kück

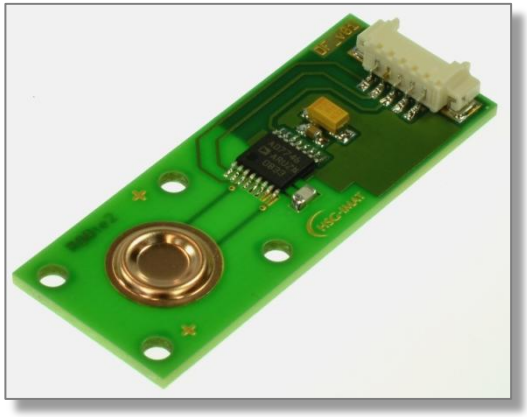
Competencies and Topics

Plastic Micro Devices

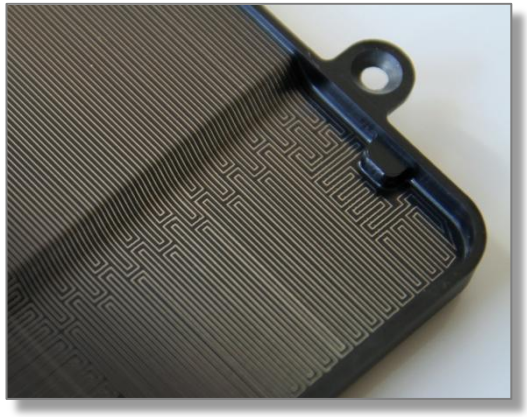
Molded Interconnect Devices



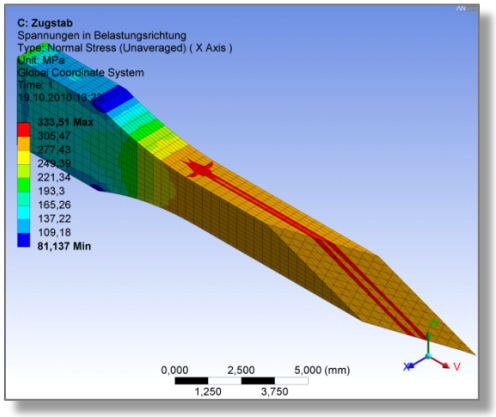
3D Micro Assembly



Sensors and Actuators



Printed Microstructures



Modeling and Reliability

MID Technology

- LPKF-LDS®-Technology
- Semi Additive MID Technology
- 2 Shot MID Technology
- Hot Embossing MID Technology
- Circuits on Thermoset Materials
- Circuits on Ceramic Devices
- PVD
- Electroless Plating and Electroplating

The HSG-IMAT TransferFab

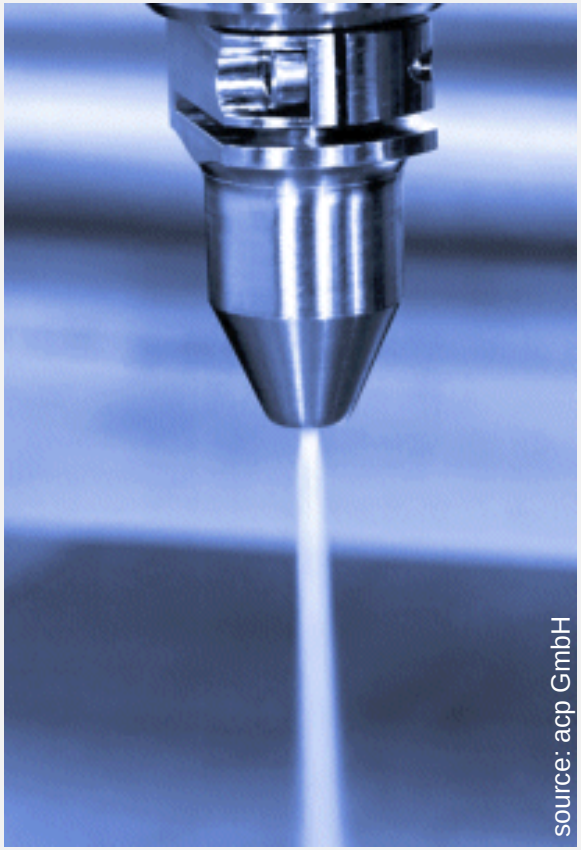
Features and Benefits:

- Real prototypes within few weeks
- Small series production
- Process transfer
- MID and other miniaturized systems
- All MID processes in house
- Machinery suitable for industrial manufacturing
- Automated processes
- Certified according to ISO 9001:2008

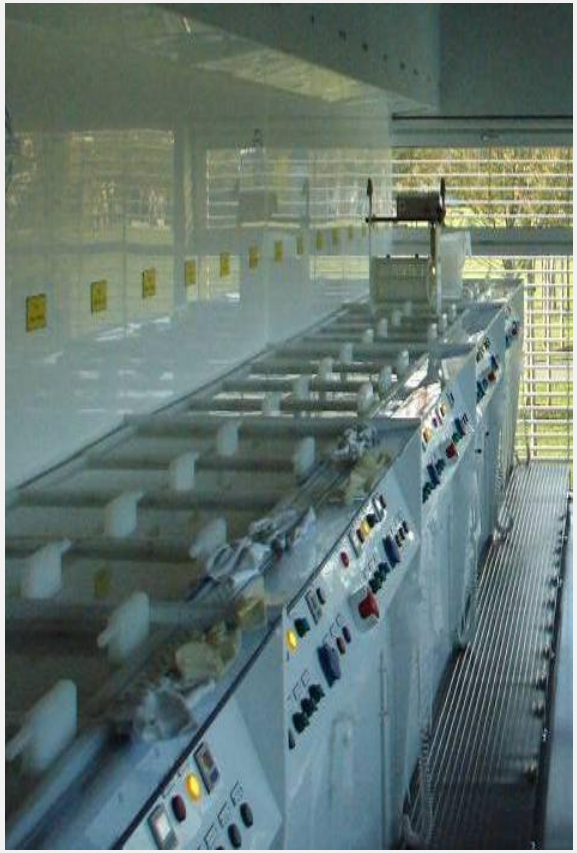
HSG-IMAT TransferFab Processes

Laser Patterning, Cleaning and Electroless Plating

Laser Patterning



CO_2 snow jet cleaning

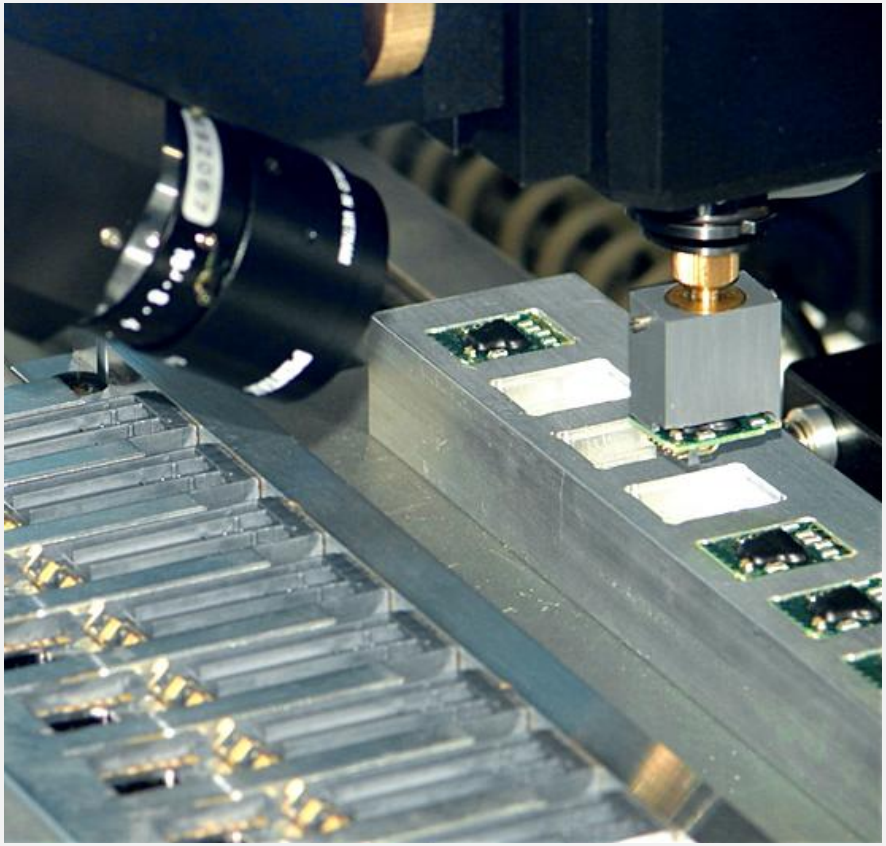


Plating

HSG-IMAT TransferFab Processes

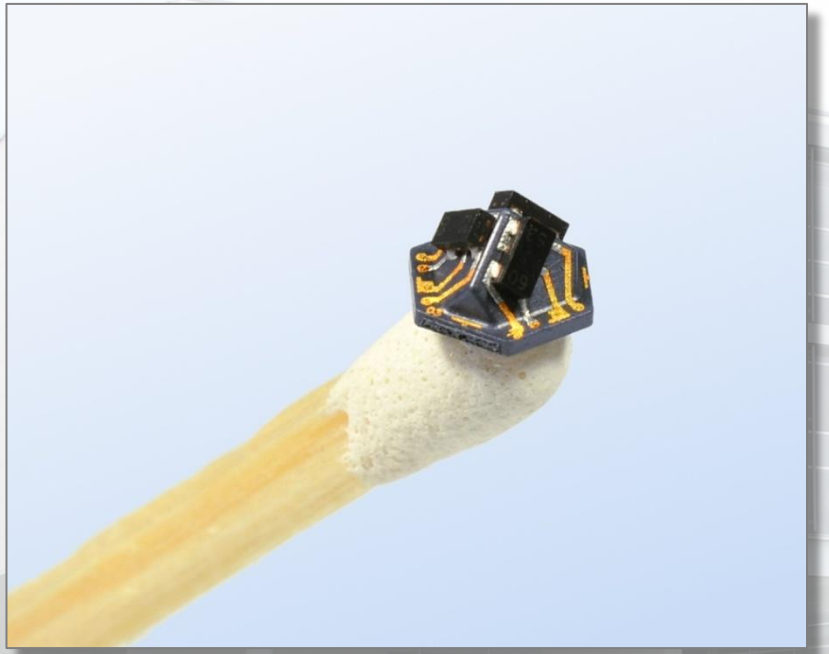
Assembly of Chips and SMD, 3D Micro Assembly

Automated 3D assembly cluster



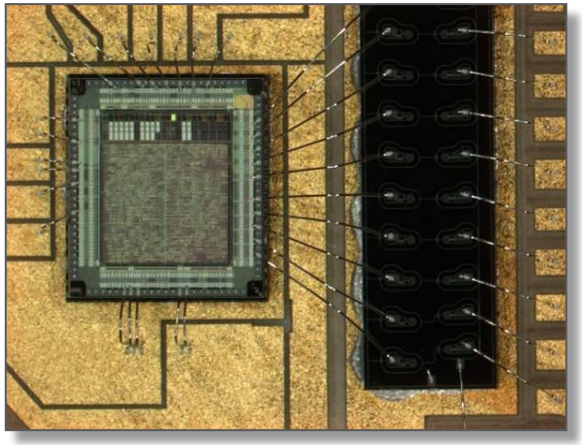
3D assembly of MID braille modules

3D Micro Assembly

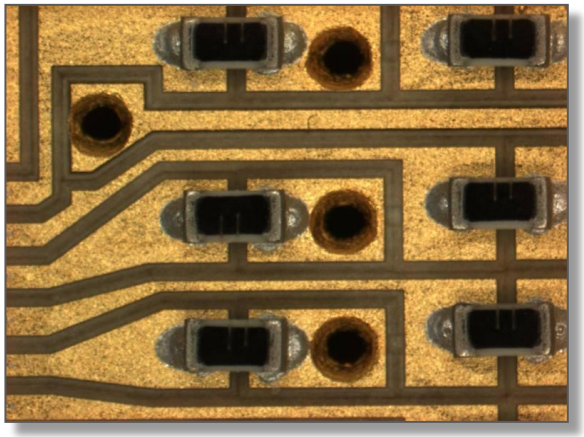


- SMD and Chip Assembly
- Flip Chip and Wire Bonding
- Assembly of Sensor and Actuator Devices
- Assembly of Optical and Optoelectronical Devices
- Micro Assembly on 3D Carriers
- Solder and Adhesive joining

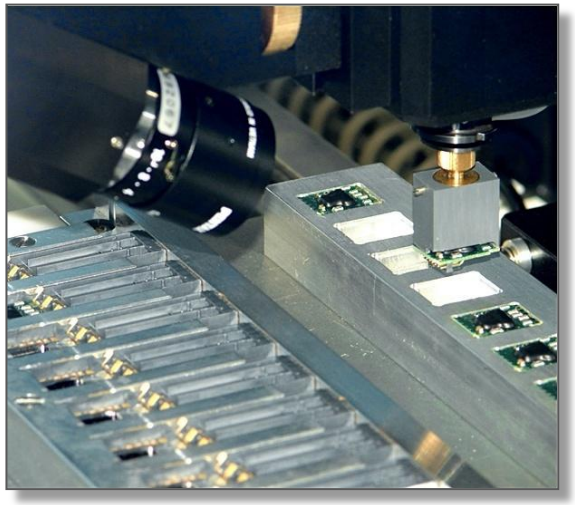
Chip-, SMD- and Micro Assembly



Wire Bonding on MID



Adhesive Attach of SMD

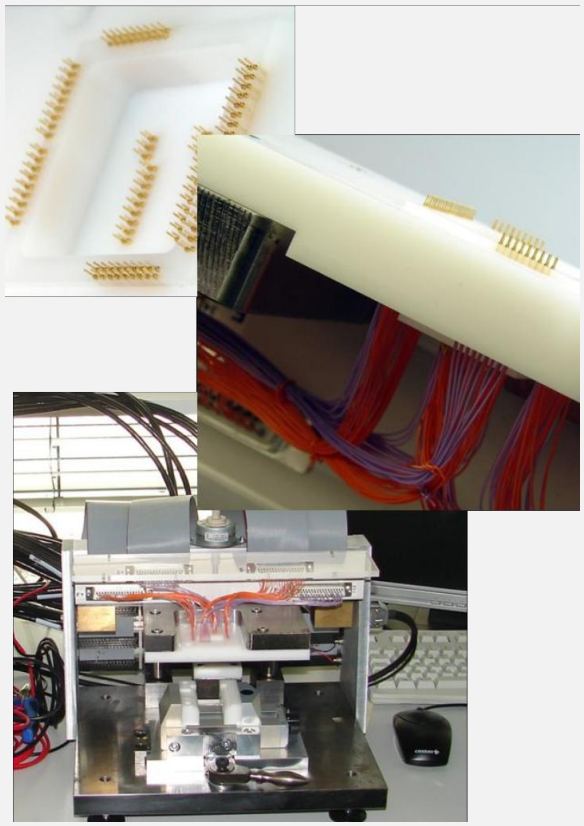


Pick and Place

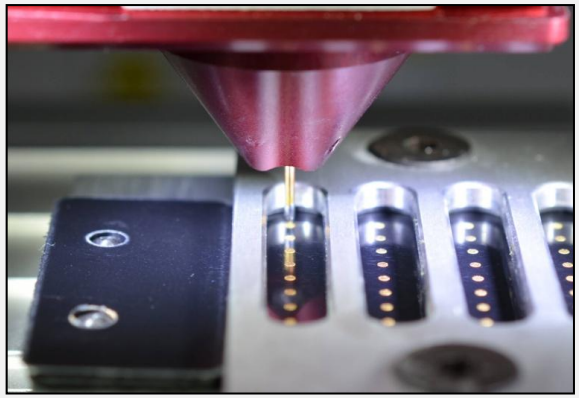
Lead Free Soldering

HSG-IMAT TransferFab Processes

Electrical, Mechanical, Optical, Environmental Testing



Electrical testing

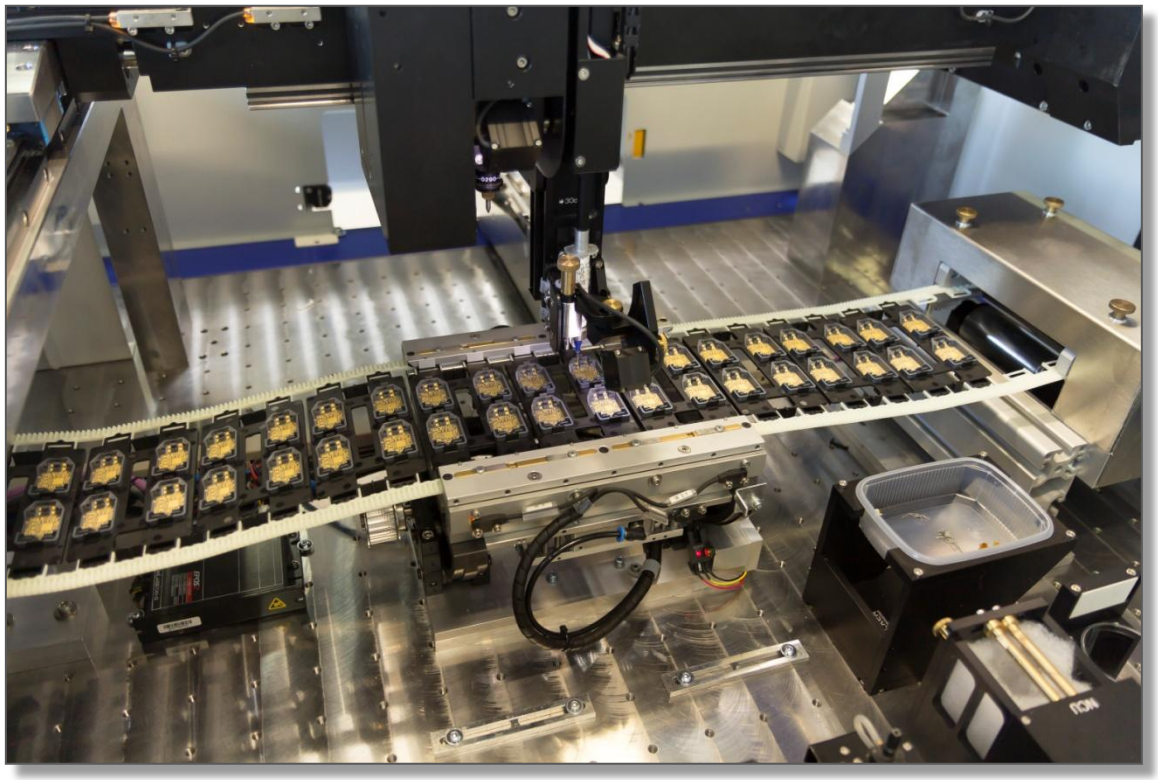


Hot bump pull test

Thermal shock test

Research: PRONTO R2R-MID

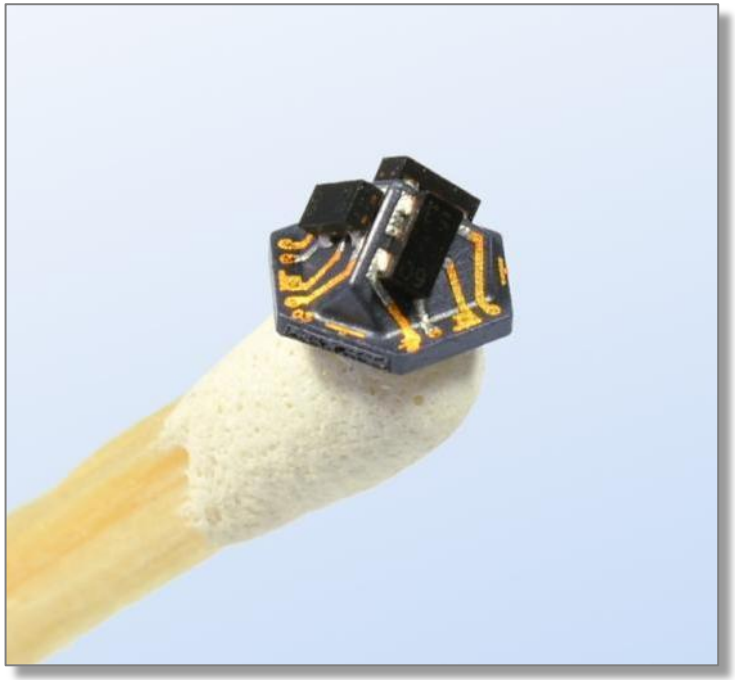
- Reel-to-Reel production of LDS MID

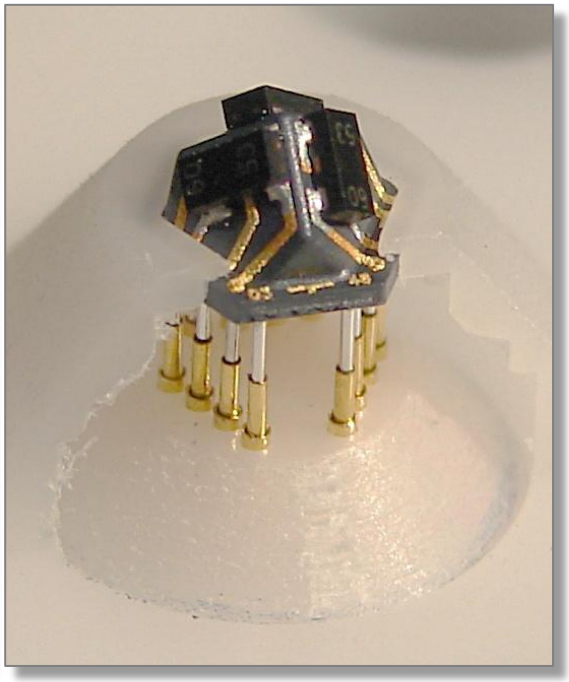


Research: ADIMA-3D

3D Micro Assembly of SMD and Integrated Characterization

- 3D magnetic field sensor system based on low cost SMD
- MID can be handled as SMD itself



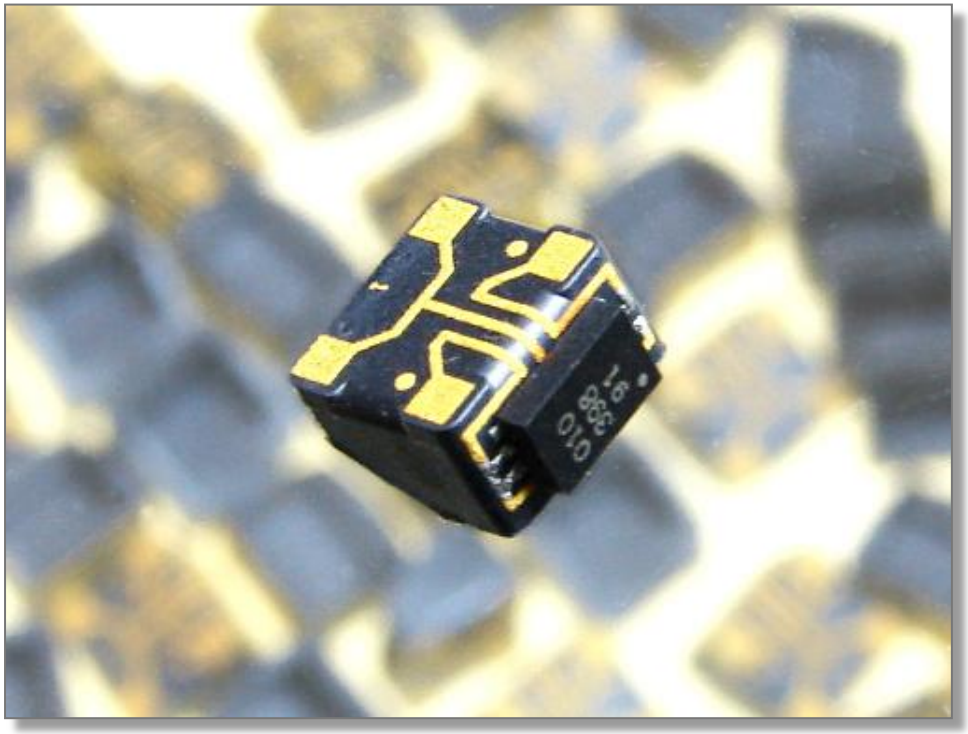


IGF Vorhaben 17163 N: ADIMA-3D

From Customer Idea to Production and Ramp up

Sensor Carrier

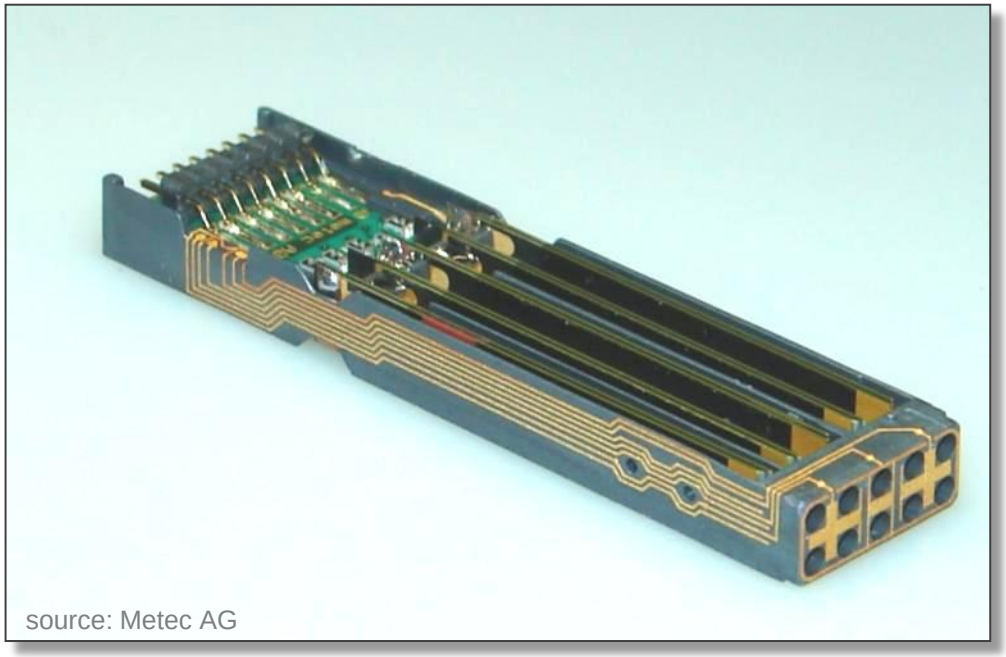
- Initial design
- Optimization by simulation
- Real samples
- Characterization and reliability tests
- Optimization and redesign
- Prototyping
- Series production



Sensor element for brushless DC motor

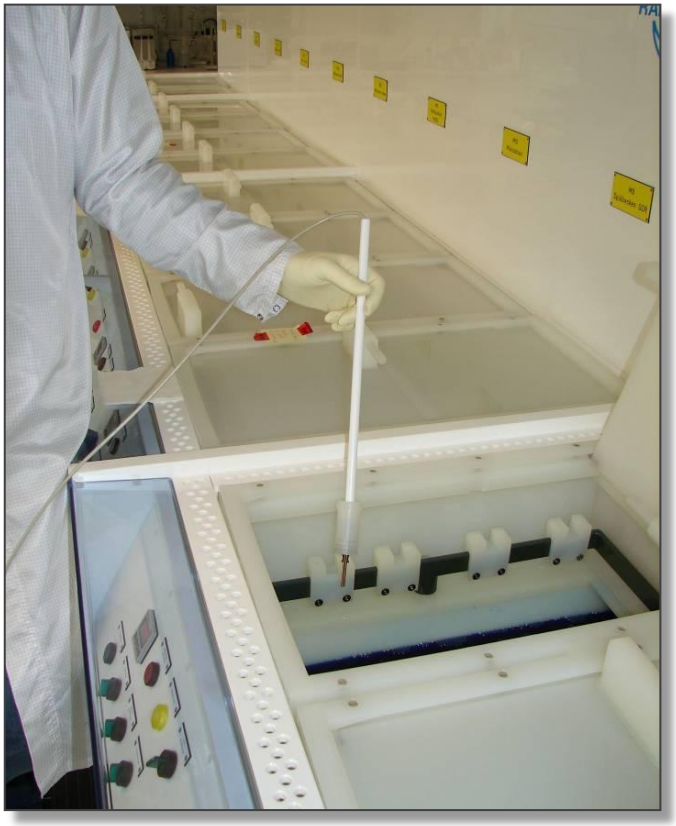
Series Production of Hybrid MID

- Laser patterning from four sides
- Adhesive based 3D assembly of PCB into MID

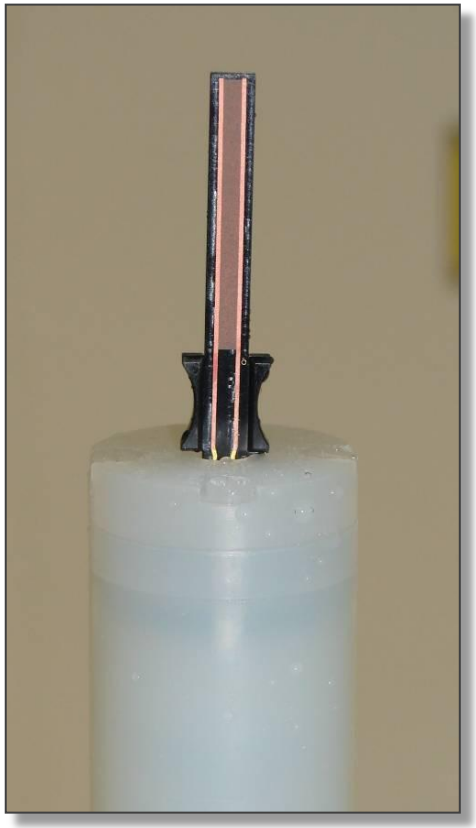

source: Metec AG

e-Cu:Check - Measurement System for Electroless Copper Deposition on MID

MID Probe



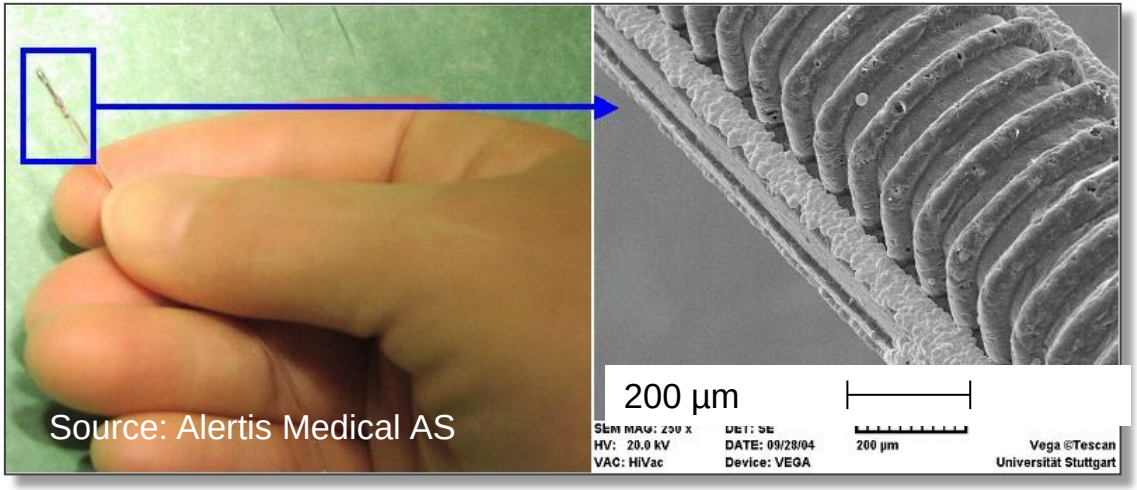
Measurement in Progress



Probe after Measurement

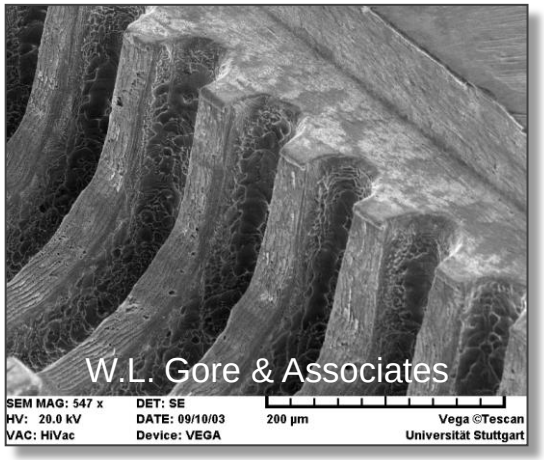
LPKF-LDS® Technology on Micro Injection Molded Parts

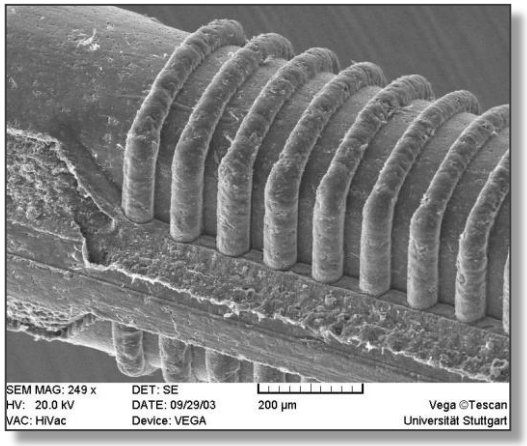
Microsensor



LDS-MID

Mold cavity





LDS-MID

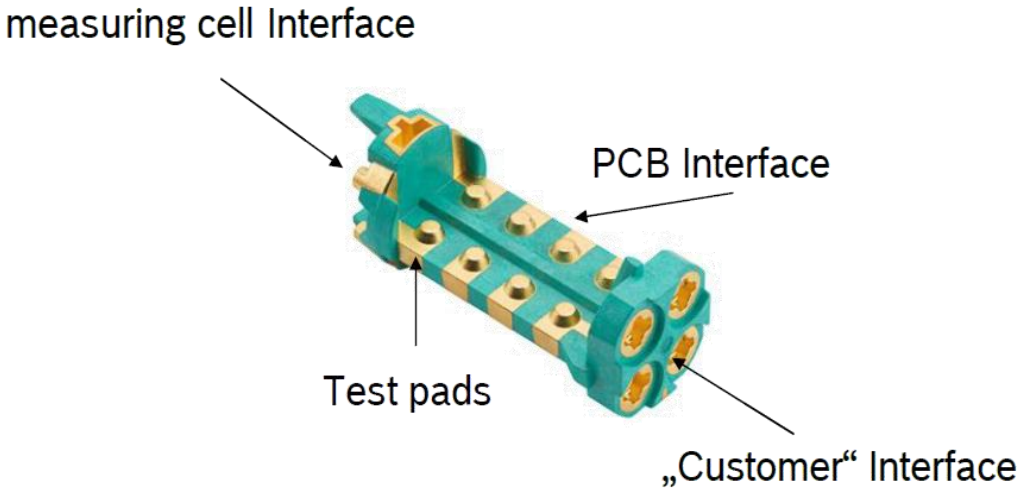
Robust MID Sensor Holder

Proven reliability of RPM-sensor at HSG-IMAT in a research project in cooperation with Robert Bosch GmbH

- Temperature Shock Test (TST)
  - -40 to 150°C, Transition time<10s, > 2000 cycles
- Enviromental Testing (FWL)
  - 85°C and 85% relative humidity, > 2000 Hours

Subsequent development of a MID sensor holder for ABS system by Robert Bosch GmbH

- Fabrication of > 10 Mio. p.a. by Bosch



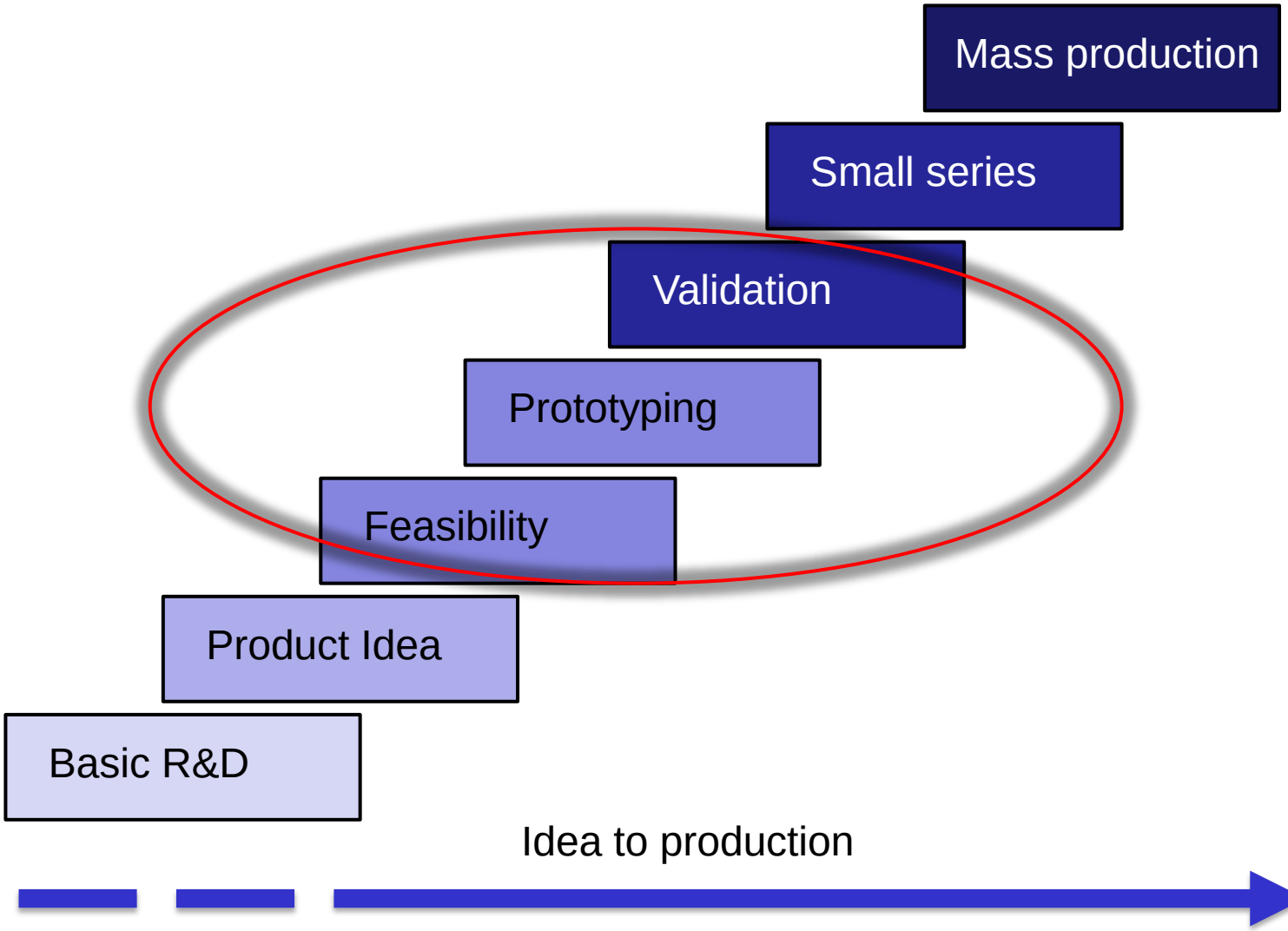
HSG-IMAT TransferFAB

R&D

Prototype, Validation,
Pilot and Small Series
Process transfer

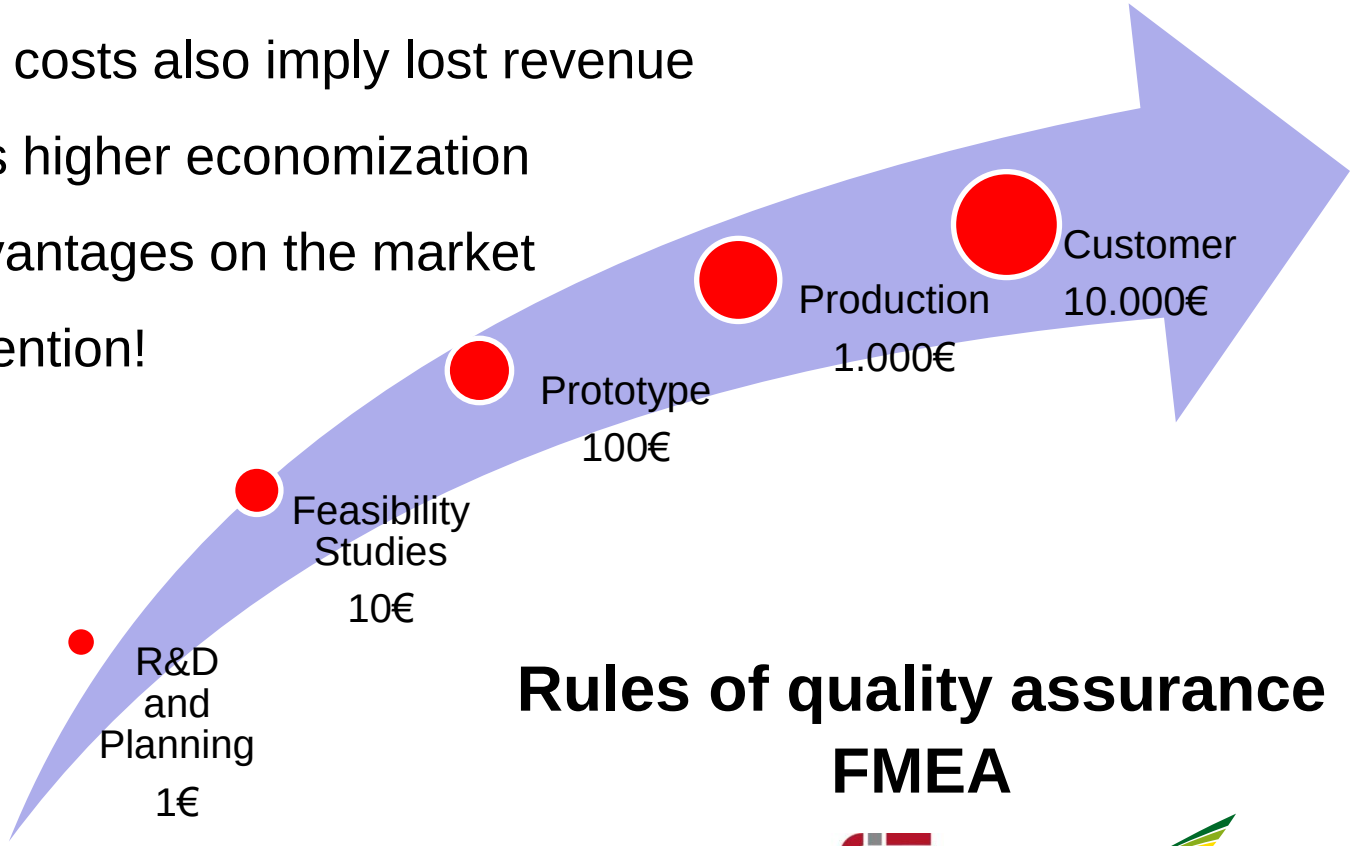
Industrial
Commercialization

Development Stages



Costs of Non-Conformance

- Costs of fault recovery increase the further the development has progressed
- Failure avoidance has to start in the early development stages
- Non-Conformance costs also imply lost revenue
- Less failure equals higher economization
- Consequently: advantages on the market
- Goal: Failure prevention!



Rules of quality assurance

FMEA

“Rapid Prototyping“ of MID

HSG-IMAT

3D-part	Preprocessing	Metallization	Assembly
3D printing STL/SLA Casting MJM SLS FDM	Conductive lacquer CVD/PVD Electroless full plating	Semiadditive / Subtractive laserpatterning	3D assembly with conductive adhesive (Soldering) …
	Tampon printing Aerosol printing Inkjet printing Plasma spraying	Reinforcing by e-less plating	
	Proto Paint Powder coating	Laser activation + e-less plating	
HSC	Repassivation		

Rapid Prototyping of MID

Drawbacks of Rapid Prototyping

- Different materials and processes are used
- Different thermal / thermomechanical properties and surface quality
- Different residual stress compared to molded parts
- Subsequent processing (laser patterning, metallization, assembly) with limitations

➢ No functional testing of real applications possible

➢ No reliability proof possible

Image by Souverein Weesp B.V.

Relevant Functional Properties of MIDs

HSG-IMAT

Electrical Properties
- Insulating properties
- Dielectric properties
- Dielectric strength

Metallization
- Adhesion
- Roughness
- Fine pitch capability

Material Properties
- Flowability
- Moisture absorption

Source: R.E.T. Reiff GmbH, HSG-IMAT

Thermal Properties
- Thermal expansion
- Thermal conductivity
- Thermal stability

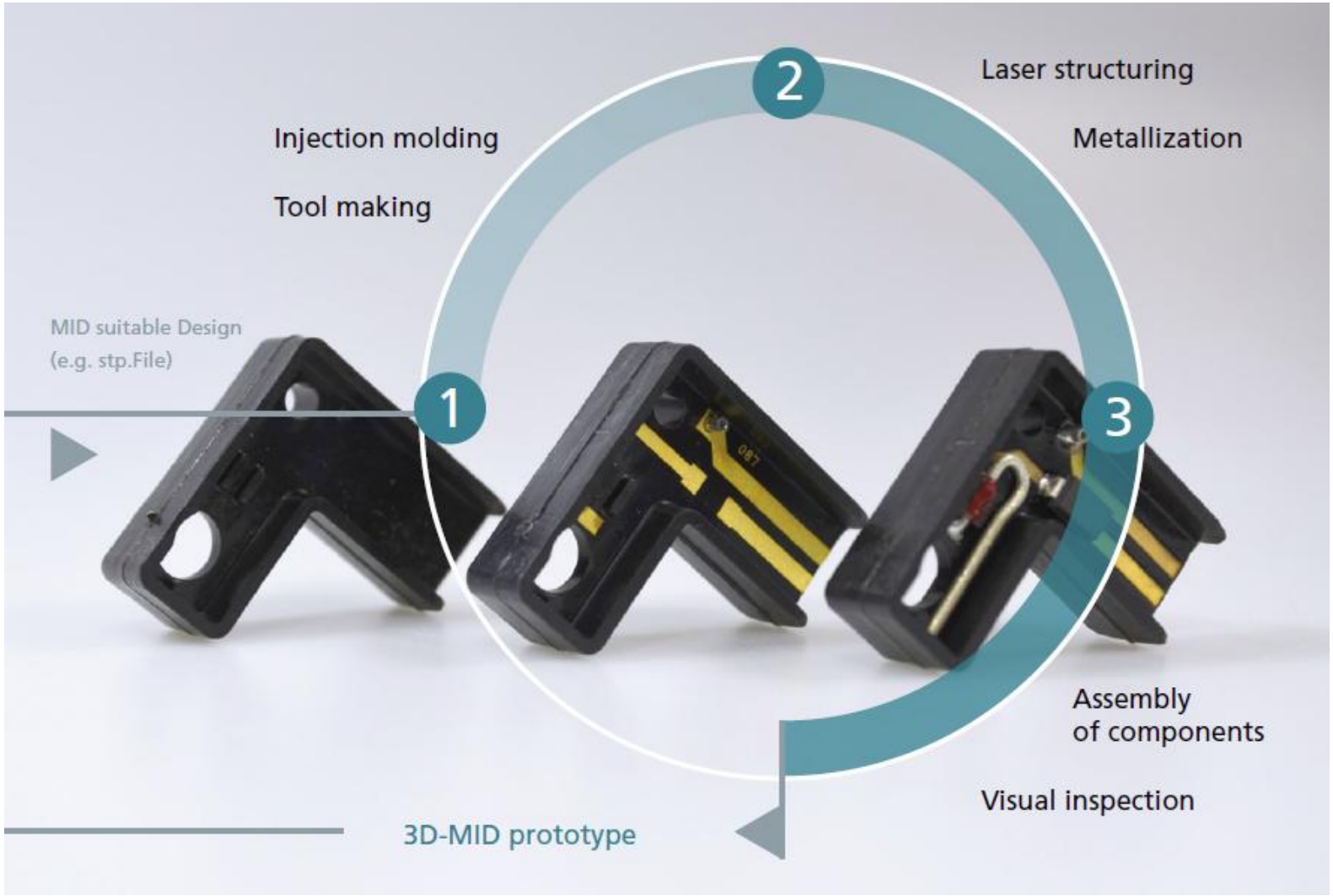
Assembly Compatibility
- Chip assembly
- Soldering

Reliability

Mechanical Properties
- Rigidity
- Solidity

Relevant functional properties can only be verified with molded parts

3W-MID Prototype Cycle



HSG-IMAT Offer

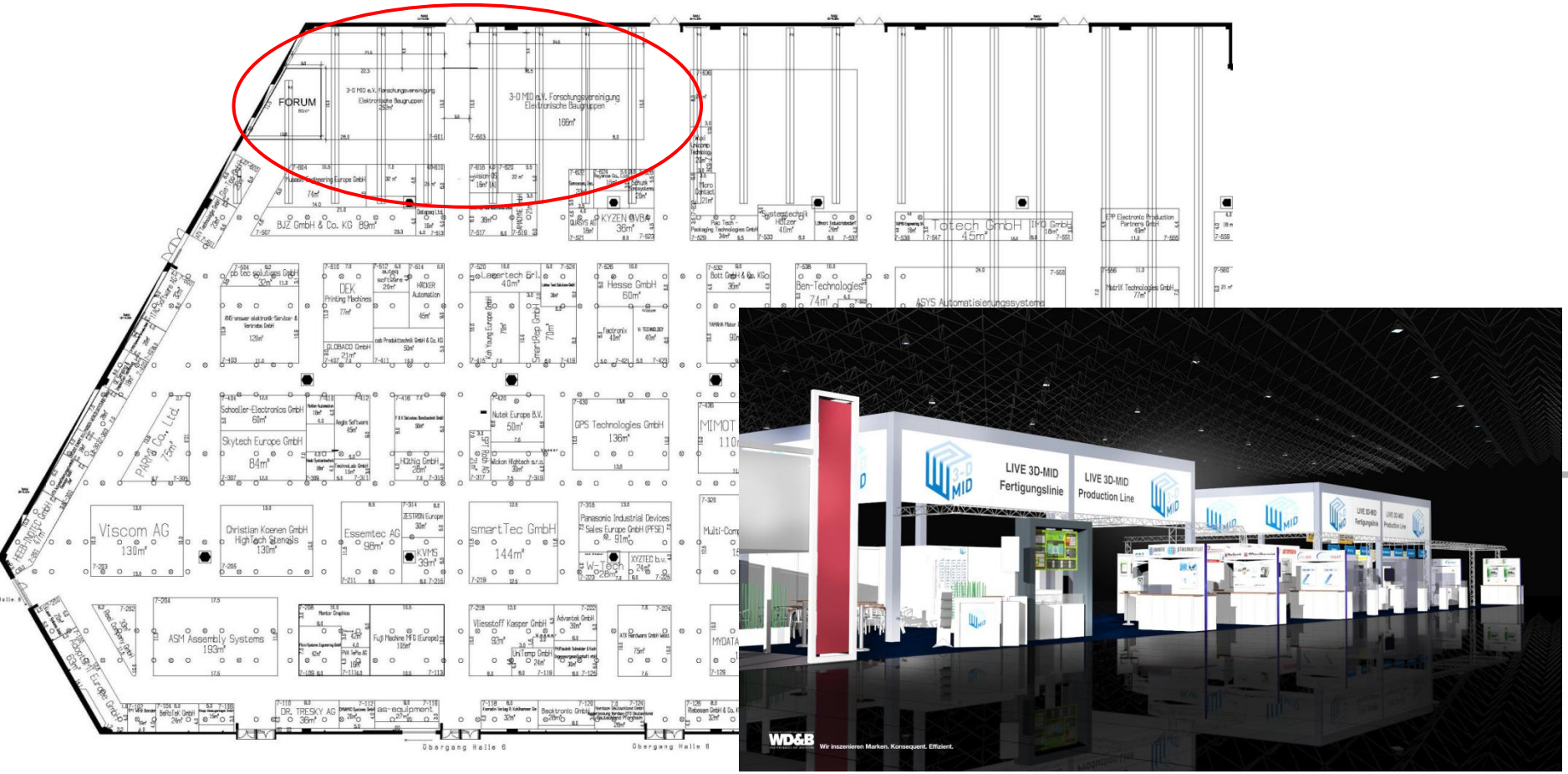
3W-MID basic package:

Quantity:	20 MID-Devices
Material:	LCP Vectra E840i LDS
Geometry:	Feasible by open/close tooling
Laser structuring:	Exposure with up to 2 clamping set-ups
Metallization:	Cu (10±3 µm) / NiP (5±2 µm) / Au (0.1±0.05 µm)
Inspection:	Visual inspection
Price:	starting from 9.990 EUR
Time to delivery:	from 3 weeks onwards after approval of design
Terms and conditions:	HSG-IMAT

Assembly of components by all common techniques. Variations of offer on request.

Donnerstag, 08.05.2014
Thursday, 08 May 2014

10:00-10:30	**3D-MID – Coming from Prototypes to Production** Dr. Thomas Günther, HSG-IMAT
12:00-12:30	**Selektive Kunststoffmetallisierung mittels Primertechnologie** Stefan Glöde, Lüberg Elektronik GmbH & Co. Rothfischer KG
14:00-14:30	**Integration halbautomatisierter Routingverfahren für räumlich spritzgegossene Schaltungsträger in CAD Tools** Jochen Zeitler, Universität Erlangen-Nürnberg, Lehrstuhl FAPS



Thank you for your attention!

Contact:
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