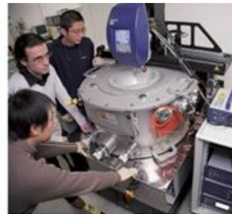
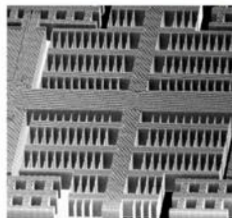
Welcome to the Chemnitzer Seminar "System Integration Technologies"





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TECHNISCHE UNIVERSITÄT CHEMNITZ

ZfM
Zentrum für Mikrotechnologien

Fraunhofer
ENAS

Smart Systems Campus Chemnitz

smart systems campus
TechnoPark Chemnitz

A – Institute of Physics and Center for Microtechnologies at the CUT

B – Fraunhofer ENAS

C – Start-up-building

D – Lightweight Structures Engineering

E – 3D-Micromac AG

F – Microflex Center Chemnitz (3D-Micromac AG, Fraunhofer ENAS)

G – MAIN

H – EDC Electronic Design Chemnitz GmbH

I – Competence Center IT and Catering

Fraunhofer Institute for Electronic Nano Systems

Director: Prof. Dr. T. Gessner
Deputy Directors: Prof. T. Otto and Prof. S. Schulz

Rep. Office Manaus Brazil

Rep. Office Shanghai China

Rep. Office Tokyo/Sendai Japan

Multi Device Integration (OE 610) Prof. Otto

Printed Functionality (OE 630) Prof. Baumann

System Packaging (OE 650) Dr. Wiemer

Administration Mr. Höppner

Micro Materials Center (OE 620) Prof. Rzepka

Back-End of Line (OE 640) Prof. Schulz

Advanced System Engineering (OE 660) Dr. Hedayat

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Main working fields

International Offices of Fraunhofer ENAS:

Since 2001/2005	Tokyo/Sendai, Japan
→ Since 2012	Project-Center in Sendai
Since 2002	Shanghai, China
Since 2007	Manaus, Brazil

Systems integration by using of micro and nano technologies

- MEMS/NEMS design
- Development of MEMS/NEMS
- MEMS/NEMS test
- System packaging/waferbonding
- Back-end of Line technologies for micro and nano electronics
- Process and equipment simulation
- Micro and nano reliability
- Printed functionalities
- Advanced system engineering

2014 - Kernkompetenzen der Abteilung 500

Fraunhofer ENAS

Department System Packaging

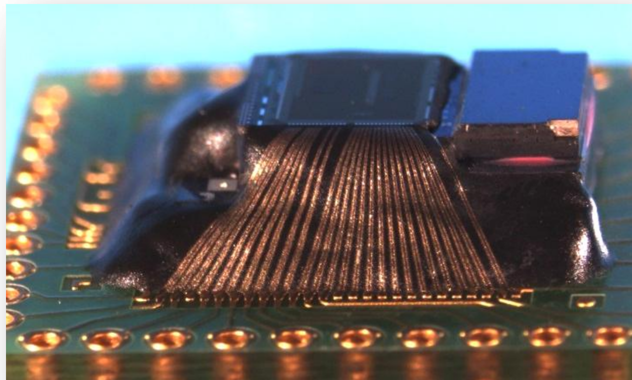
Department Manager: M. Wiemer, Deputy J. Frömel
Secretariat: S. Lötsch, U. Weltsch

Materials & Technologies

(Group Leader: F. Roscher)

Topics

- Aerosol-Jet deposition
- Screen printing (Contacting, Bonding)
- Bonding by Nano effects (ionic liquids)
- Bond characterization



Printed Interconnect for industrial automization

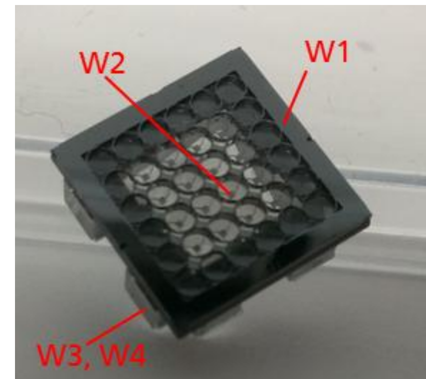
Scientists: Roscher, Seifert, Saeidi, Vogel, Hertel, Reich

Integration technologies

(Group Leader: M. Baum)

Topics

- Temporarily and permanent bonding
- MEMS Packaging (medical and acoustic applications, harsh environment)
- Integration technologies (3D MEMS+ electronics)
- Nanoimprinting



MEMS Packaging for medical decives

Scientist: Baum, Frömel, Wünsch, Haubold, Gabler, Hofmann, Wang

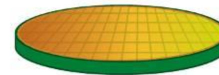
Operators: Kinner, Uhlig, Lesner
Service: wafer dicing, wire bonding, analytics, sample preparation

Temporary waferbonding – key technology for 3D-Integration

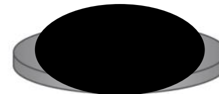
brewer science

Mean processes for temporary waferbonding

- Preparation of device wafer

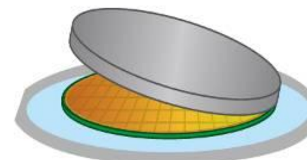


- Preparation of carrier wafer



- Adhesive waferbonding

- Wafer de-bonding



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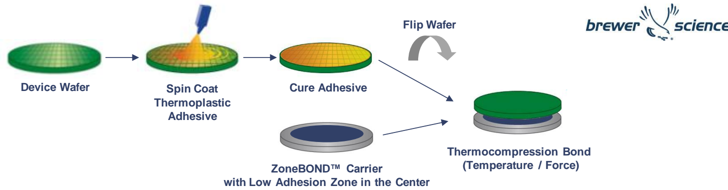
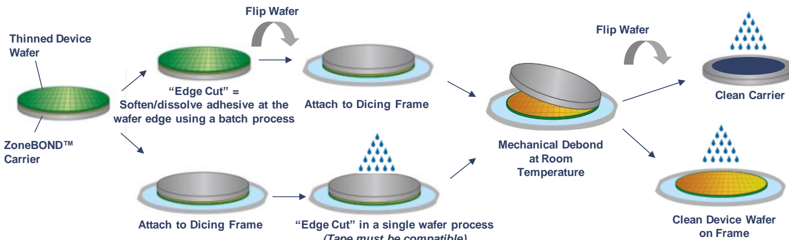
Temporary waferbonding – key technology for 3D-Integration

TEMPORARY BOND WITH THERMOPLASTIC ADHESIVE



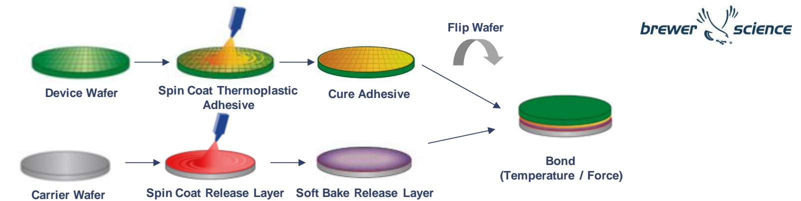
ROOM TEMPERATURE PEEL-OFF DEBOND



(1) The use of Brewer Science® ZoneBOND® technology requires a separate license agreement with BrewerScience

Fig.: Process flow of Zone-Bond de-bonding process (Zone-Bond)

TEMPORARY BOND WITH THERMOPLASTIC ADHESIVE



ROOM TEMPERATURE PEEL-OFF DEBOND

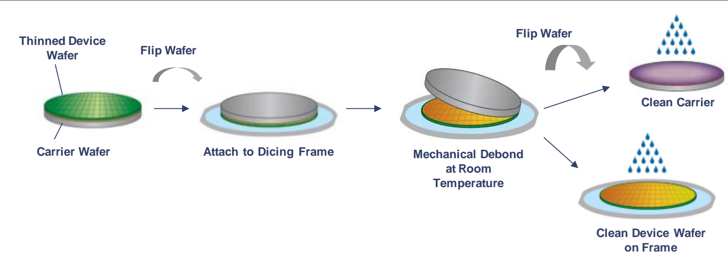


Fig.: Process flow of new temporary zoneless de-bonding process (Brewer-Bond)

- Mechanical room temperature over peel-off process
- Two Zone carrier needed
- Edge release needed

- Mechanical room temperature over peel-off process
- One Zone carrier
- Edge release not needed

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Temporary waferbonding – key technology for 3D-Integration

- Different Methods established with different requirements regarding thermal, chemical and mechanical stress

Traditionally Methods:

- Thermal slide, Laser release

New Trend:

- Mechanical room temperature over peel-off process

- **Zone-Bond de-bonding process (Zone-Bond); New: zone-less de-bonding process (BrewerBond)**

ENAS-focus:

- Zone-less de-bonding process from Brewer Science with temporary waferbonding over an adhesive
- Reason → room temperature de-bonding technology

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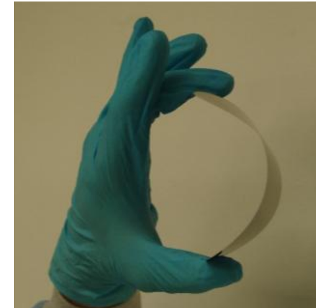
Temporary waferbonding – key technology for 3D-Integration

- ENAS method → adhesive temporary waferbonding
- Complete process flow to fabricate thin wafer (up to 50µm) → ZoneBond process established
- Research focus: from Zone-Bond to zone-less de-bonding techniques to reduce process time and costs
- Critical: cracks on wafer edge after wafer thinning



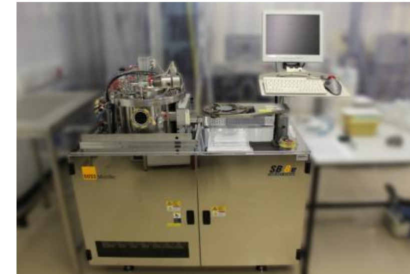


Abb.: waferbonding system (SÜSS-SB 8e)

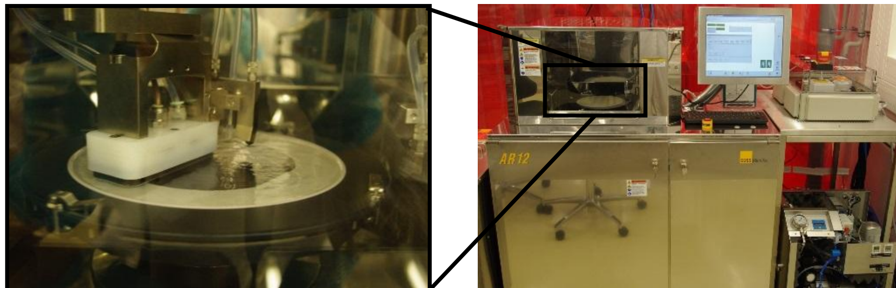


Fig.: Puddle-dispense cleaning of thin device wafer on tape frame

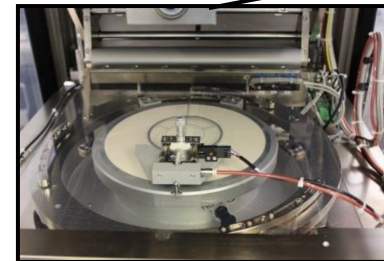


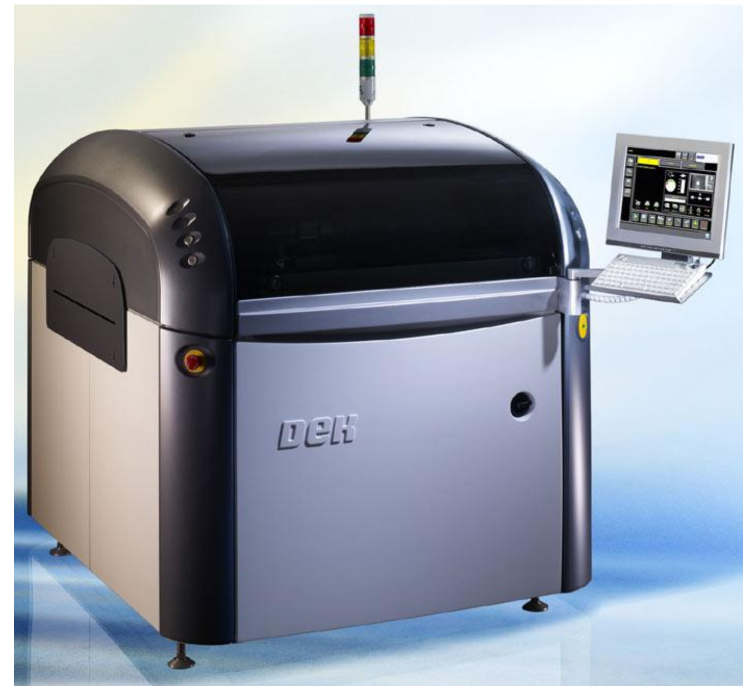
Abb.: De-bonding (SÜSS-DB 12T) and Coater system (SÜSS RCD 8)

Technology Screen Printing

DEK Horizon 03iX

Strukturmorphologie: Lateral 50 µm - 150 mm;
Vertikal 10 µm - 1 mm

- Screen frame: 736 x 736mm (29" x 29") standard
- Printable Area (510mm x 508.5mm)
- *Modul for Via Filling*
- *Modul for Dispensing*
- Vector Guard stencil printing
- Machine Alignment >2 Cpk @ +/- 12.5µm, 6 Sigma
- Process Alignment >2 Cpk @ +/- 25µm, 6 Sigma #



Source: SMTnet

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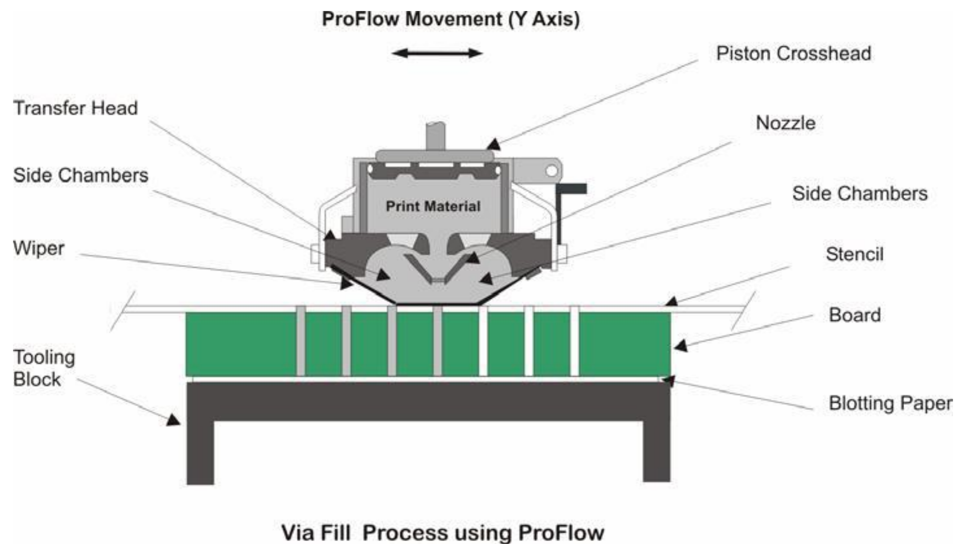
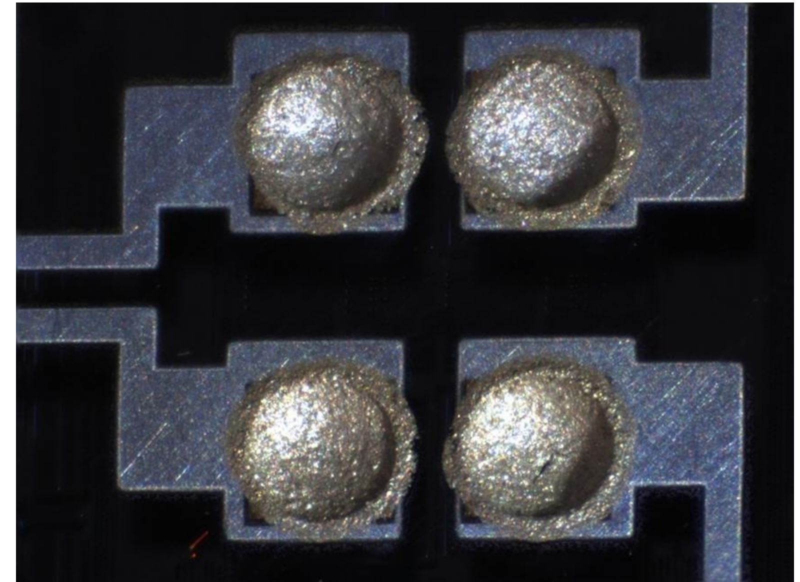
IV. Technology

DEK – Via Filling Technology Pro Flow





Filled through glass vias by stencil printing

First Day – Tuesday June 23, 2015

Time		Speaker	Company	Titel
from	to			
13:00	13:20	M. Wiemer	Fraunhofer ENAS	Welcome note, Packaging of MEMS devices – An overview
13:20	13:55	Jörg Siegert	ams AG	Open TSV technology for 3D sensor applications
13:55	14:20	Dr. Peter O'Brien	University College Cork	Packaging of integrated photonic devices; applications, user foundry services and design rules
14:20	14:45	Thomas Krebs	Heraeus Deutschland GmbH & Co. KG	Silver sinter interconnects in diversified applications
14:45	15:10	Toru Kondo	Olympus	16Mpixel 3D stacked CMOS image sensor
15:10	15:40	Coffee break		
15:40	16:05	Felix Gabler	Fraunhofer ENAS	Towards MEMS loudspeaker fabrication by using metallic glass thin films
16:05	16:30	Margarete Zoberbier	SUSS MicroTec Lithography GmbH	MEMS packaging – Infinite variety of bonding applications
16:30	16:55	Reinhard Jurisch	Microsensys	Passive RFID sensor solutions
16:55	17:20	Dr. Dieter Rammlmair	Federal Institute for Geosciences and Natural Resourcesa	Geology needs MEMS and sensors

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Second Day – Wednesday June 24, 2015

Time		Speaker	Company	Titel
from	to			
09:00	09:10	M. Wiemer	Fraunhofer ENAS	Welcome
09:10	09:35	Sven Bochmann	Turck Duotec GmbH	MEMS-based industry 4.0 applications
09:35	10:00	Dr. Ursula Palfinger	JOANNEUM RESEARCH Forschungsgesellschaft mbH	Large-area patterning by roller-based nanoimprint lithography
10:00	10:25	Steffi Proschwitz	University of Applied Sciences Zwickau KG	Applications of thermal nano imprint lithography
10:25	10:55	Coffee break		
10:55	11:20	Dr. Martin Eibelhuber	EV Group	Oxide free direct wafer bonding
11:20	11:45	Dr. Axel Müller	Klinikum Chemnitz	Telecardiology – Technical innovations and challenges in clinical practice
11:45	12:10	Marco Haubold	Fraunhofer ENAS	Packaging and fabrication opportunities enabled by the room temperature deposition of Parylene
12:10	12:35	Prof. Dr. Richard Funk	Technische Universität Dresden	MEMS and biological cells – advances in designing sensors, actuators and biocompatible surfaces for medical use
12:35	13:00	Michel Brizoux	Thales Global Services	Thales vision and need in advanced packaging for high end applications

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