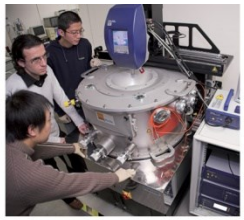
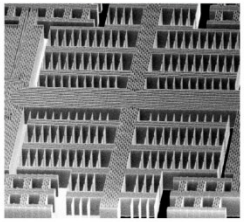
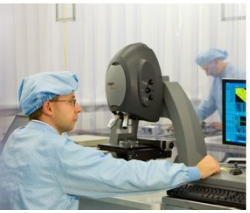
OVERVIEW FRAUNHOFER ENAS AND ZFM

Prof. Dr. Thomas Otto
Prof. Dr. Stefan Schulz
Prof. Dr. Karla Hiller





TECHNISCHE UNIVERSITÄT CHEMNITZ

ZfM Zentrum für Mikrotechnologien

Fraunhofer ENAS

In Memoriam Prof. Dr. Dr. Prof. h.c. mult. Thomas Gessner (*10.08.1954 †25.05.2016)

- Studied physics, received diploma degree in 1979 and PhD degree Dr. rer. nat. in 1983 both from Dresden University of Technology, and Dr.-Ing. habil. degree from Technische Universität Chemnitz in 1989
- Since 1993, Professor for Microtechnology at Technische Universität Chemnitz
- Since 2007, Committee Chairman of the International Smart Systems Integration Conference and Exhibition
- Founding and Board Member of EPoSS e.V., the European Technology Platform on Smart Systems Integration
- Author of more than 900 publications and 136 patents filed in 48 patent families in microelectronics, micro systems and smart systems technologies

Director of Fraunhofer ENAS

Director of the Center for Microtechnologies at TU Chemnitz

Principle Investigator at WPI-AIMR at Tohoku University Sendai, Japan

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

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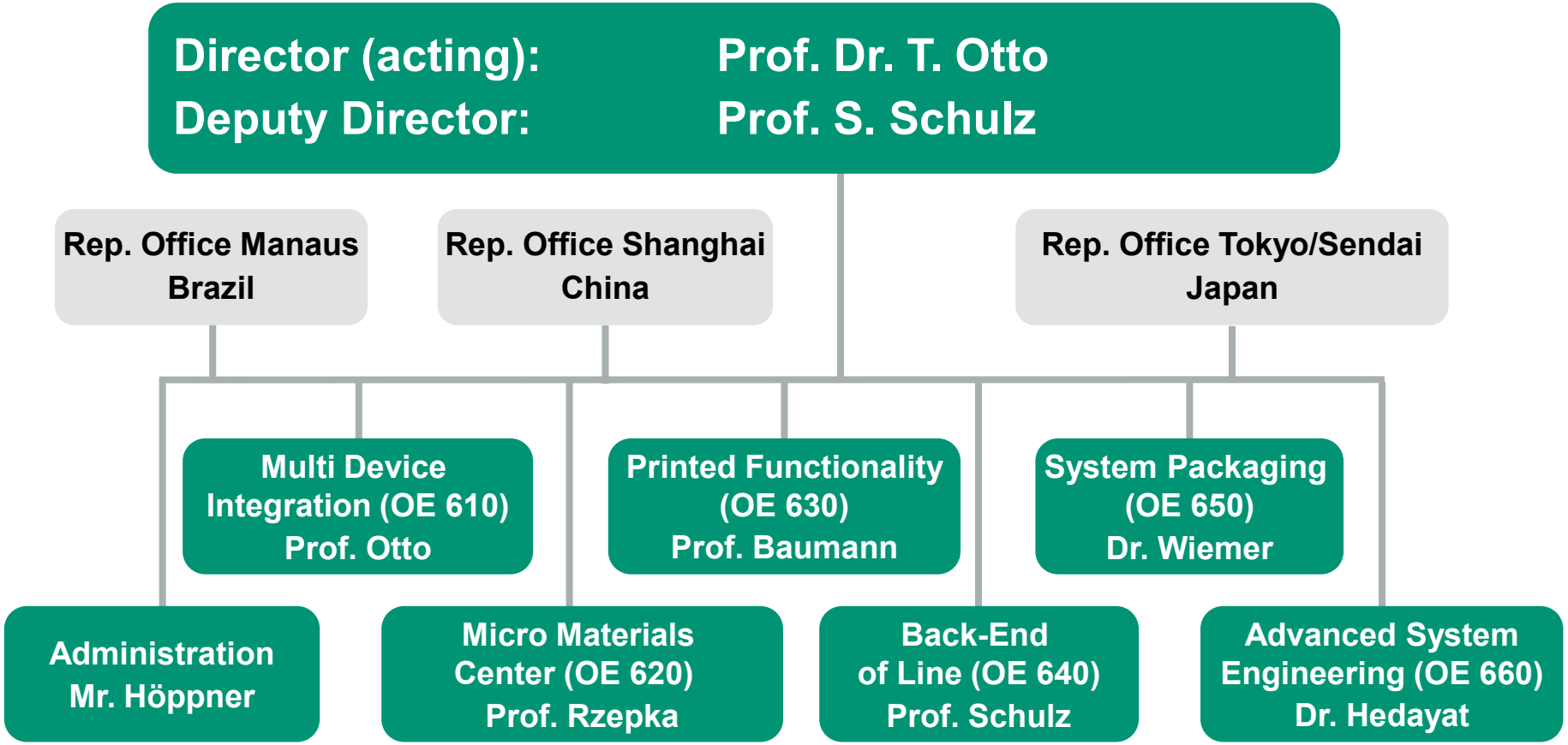
Fraunhofer ENAS

Fraunhofer Institute for Electronic Nano Systems



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Fraunhofer ENAS

Main working fields ENAS and ZFM

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

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Center for Microtechnologies

Chair Microsystems and Precision Engineering
Prof. Mehner

Chair Microtechnology
Prof. Gessner

Chair Power Electronics and Electromagnetic Compatibility
Prof. Lutz

Chair Circuit and System Design
Prof. Heinkel

ZfM Zentrum für Mikrotechnologien

Director: Prof. Gessner
Deputy: Prof. Hiller

Chair Materials and Reliability of Microtechnical Systems
Prof. Wunderle

Chair Electronic Devices of Micro and Nano Technique
Prof. Horstmann

Chair Electrical Measurement and Sensor Technology
Prof. Kanoun

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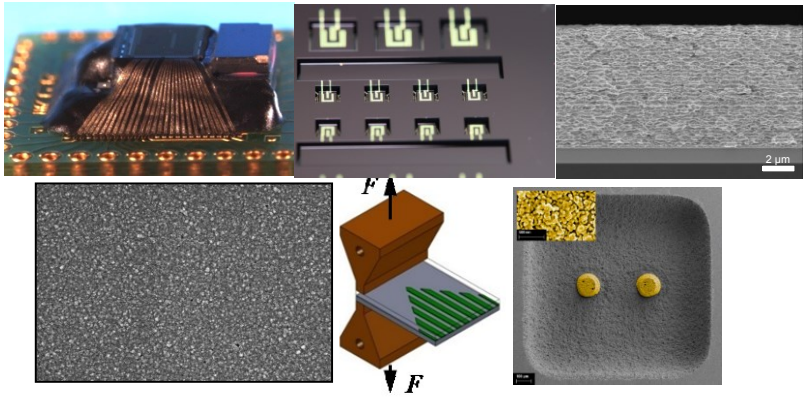
Fraunhofer ENAS

Overview System Packaging

Head: Maik Wiemer

Materials for MEMS
(F. Roscher)

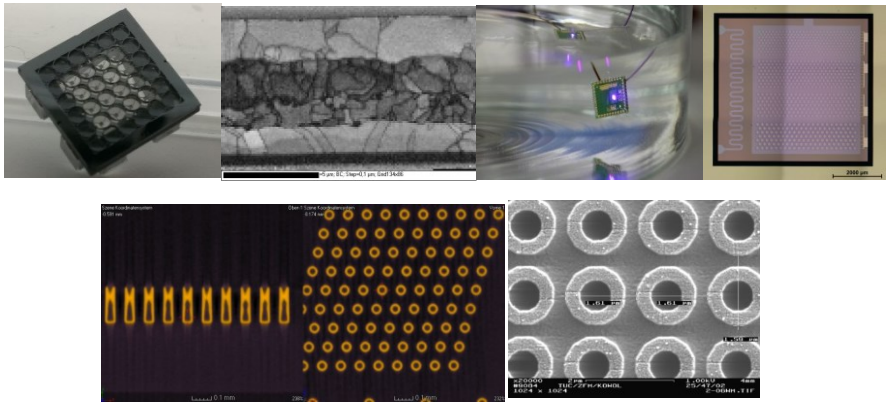
Topics
- Nano Effects for Packaging
- Material Deposition for Packaging & MEMS
- Additive Technologies



Researchers (7): Roscher, Seifert, Saeidi, Vogel, Hertel, Reich, Schröder

Integration Technologies
(M. Baum)

Topics
- Waferlevel und Chiplevel Packaging
- 3D Integration
- Devices & MEMS



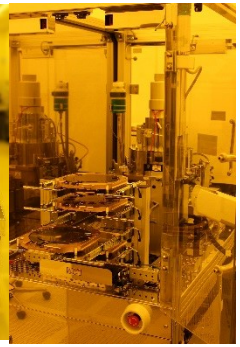
Researchers (5): Baum, Wünsch, Hofmann, Wang, Selbmann

Operator (3): Kinner, Uhlig, Lesner,
Trainee (2): Hebenstreit, Hellmann

Fraunhofer ENAS

SELECTED EQUIPMENT

Permanent Wafer Bonding	Thin Wafer Handling	Electric Contact Formation	Chip and Board Bonding	Characterisation / Realiability



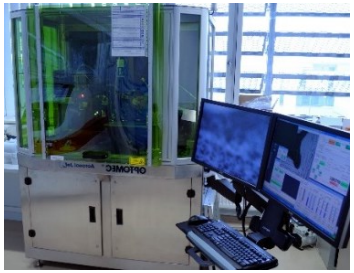
Maskaligner: NT6200

Wafer Bonder EVG 540

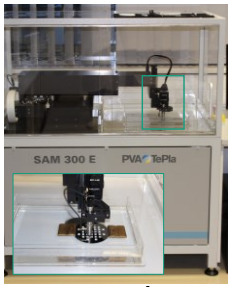
Grinder Disco DAG 810

CMP-IPEC

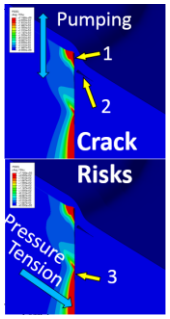
MOCVD: AMAT P5000



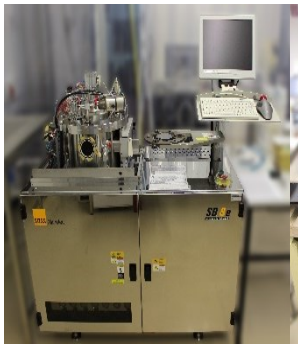
Aerosoljet



TePla SAM 300E



Simulation for Realiability



Wafer Bonder SÜSS SB8e

Bondaligner: BA 6/8

De-Bonder SÜSS DB12T

Electroplating: RENA (Fountain-Plater) und Ramgraber

Chip-Bonder Tresky

Shertest TIRA-Test

Fraunhofer ENAS

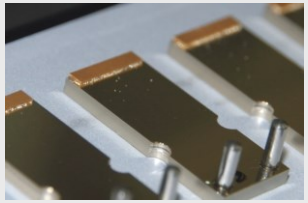
Wafer Bonding / MEMS Packaging

Smart integrated Systems

Applications

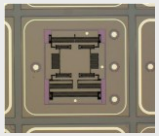
With nano layers bonded demonstrators

Flexible Substrates

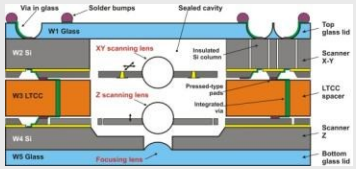


Plasma activated bonding for pressure sensors

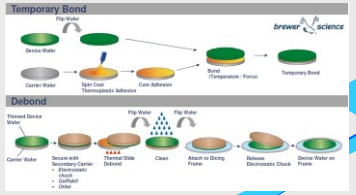
Si-Interposer Integration



Hermeticity characterization with micro resonators

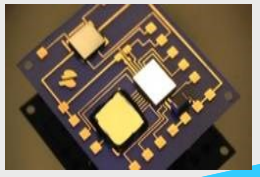


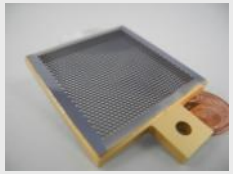
Vertically integrated 3D microscanners



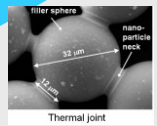
Temporary Bonding and Debonding

Interposer Integration

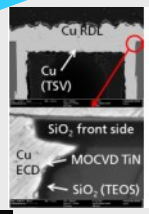




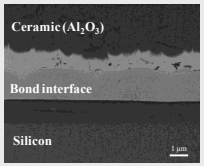
iRMS



Nano particle interconnects



Cu bonding with TSVs



Aerosol-Jet printing

SLID Bonding

New materials

* ZfM * ENAS

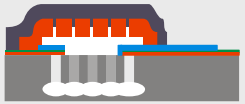
Nano Structures & Effects

3D Integration

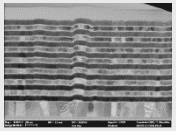
Temporary Bonding and Debonding

Functional Substrates

Self Assembly Joining

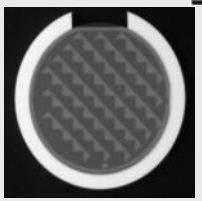


Thin film Encapsulation

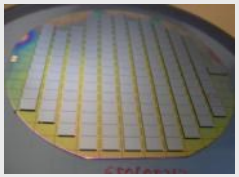


Nano Effects for Wafer Bonding

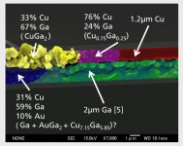
low temperature Wafer Bonding



Foturan glas wafer bonding



Thermo Compression Wafer Bonding



Bio Packaging

Technologies

2008 2009 2010 2011 2012 2013 2014 2015 2016

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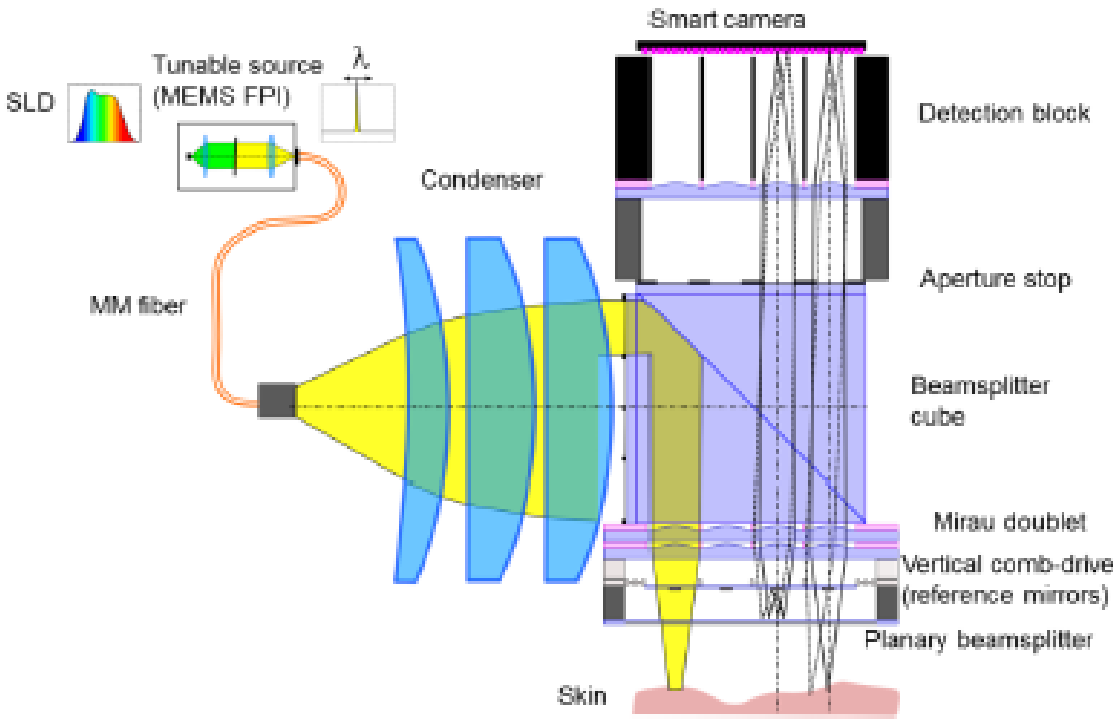
VIAMOS
Vertically Integrated Array-type Mirau-based OCT System for early diagnostics of skin cancer

Project content:

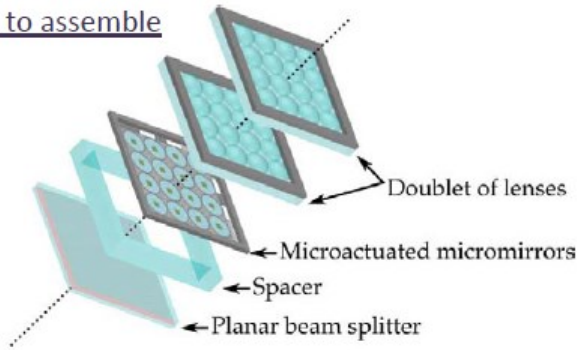
- The goal of VIAMOS is to benefit from advanced MOEMS technologies, enabling a new generation of miniature instruments. The challenge is to provide handheld, low-cost, fully parallel spectral domain miniature OCT devices (10 times cheaper, 150 times smaller), adapted for early diagnosis of cutaneous pathologies.
- Tasks of ENAS: Multi-wafer vertical assembly including functions for electric connections.

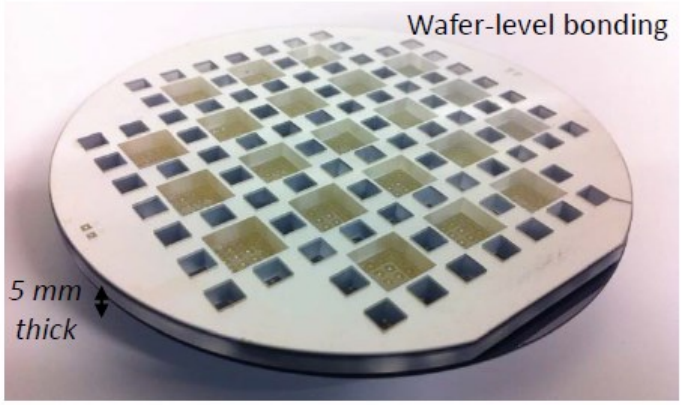
- **Grant:** EU FP7-ICT-2011-8,
- **Term:** 10/2012 – 03/2016
- **Volume:** 3.4Mio€ overall / 331k€ ENAS
- **Partner:** UFC-P5, CSEM, VTT, USTUTT, STAT, DERM



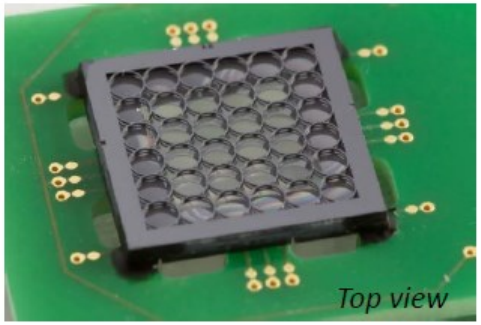
Assembled Mirau µ-interferometer

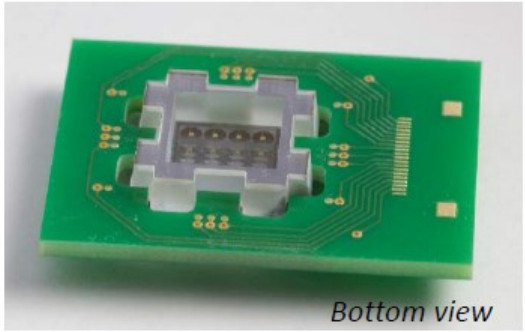
7 wafers to assemble





Diced chips: 6 mounted on PCB (+2) have been delivered:





***Proc. of SPIE**, vol. 9890, 989011 (2016)*

Vertical integration of array-type miniature interferometers at wafer level by using multi-stack anodic bonding

Wei-Shan Wang[a], Maik Wiemer[a,*], Joerg Frömel[a], Tom Enderlein[a], Thomas Gessner[a,b], Justine Lullin[c], Sylvester Bargiel[c], Nicolas Passilly[c], Jorge Albero[c], and Christophe Gorecki[c]
[a]Fraunhofer Institute for Electronic Nanosystems, Technologie Campus 3, 09126 Chemnitz, Germany; [b]Technische Universität Chemnitz, 09107 Chemnitz, Germany; [c]FEMTO-ST Institute, 15B, Avenue des Montboucons, F-25000 Besançon, France

ABSTRACT

In this work, vertical integration of miniaturized array-type Mirau interferometers at wafer level by using multi-stack anodic bonding is presented. Mirau interferometer is suitable for MEMS metrology and for medical imaging according to its variously, lateral resolutions and working distances. Miniaturized Mirau interferometer can be a promising candidate as a key component of an optical coherence tomography (OCT) system. The miniaturized array-type interferometer consists of a microlens doublet, a Si-based MEMS Z scanner, a spacer for focus-adjustment and a beam splitter. Therefore, bondings technologies which are suitable for heterogeneous substrates are of high interest and

Al-deposition by ionic liquids to replace typical metallisation processes used in information and communication technologies

„AioLi“

- **Grant-aided by**
  - BMBF, IKT 2020
- **Duration**
  - 10/2015 – 03/2018
- **Volume proposed**
  - 1,8 Mio€ overall / 631 k€ SP
  - 40 MM R&D
  - 4 MM Operator
  - 18 MM Student (10 MM without Bachelor, 8 with Bachelor à 25h/month)

Short Project Overview

- Synthesis of novel ionic liquids for ECD of aluminium on different substrate materials
- Extensive investigations of the processability of depostited Al with the technologies of electrical engineering and packaging
- Aim: Development of an ECD process of Al including deposition equipment and evaluation of various demonstrators in the fields of automotive, industry electronics, medical and telecommunication

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First results „AioLi“

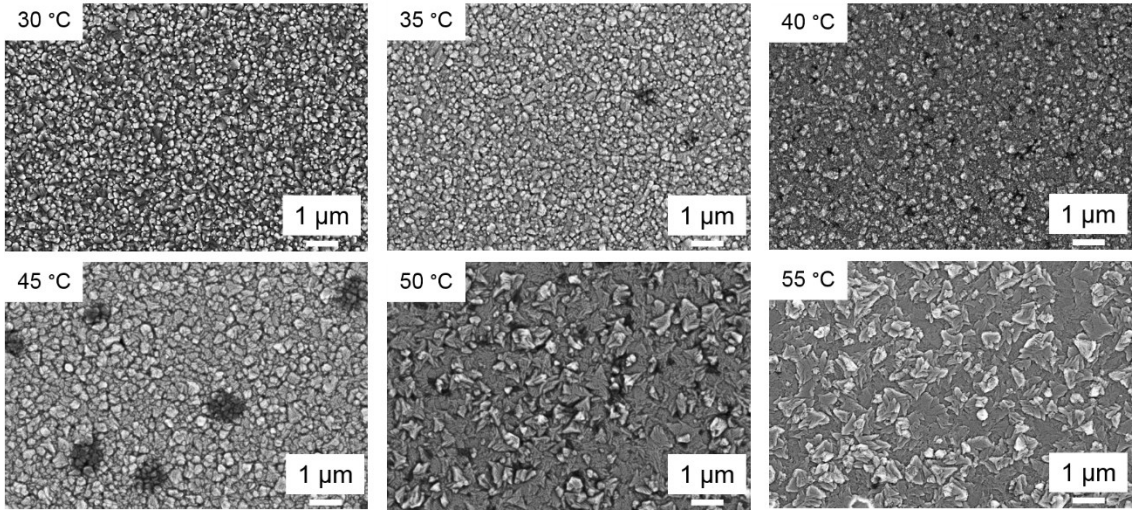

Fig. 1: SEM images of electrochemical deposited Al layers at different temperatures: Temperature of the ionic liquid influence the Al microstructure: increased temperature results in increased grain sizes

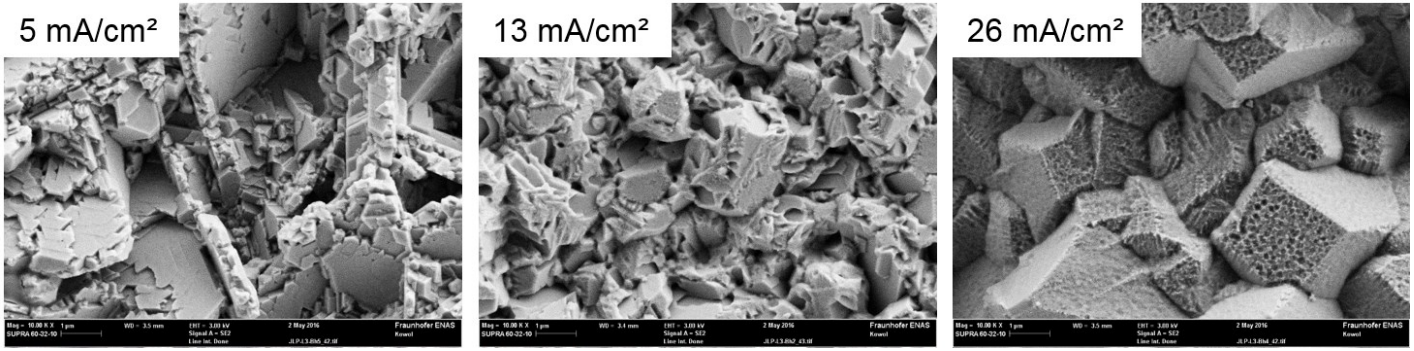

Fig. 2: SEM images of Al layers deposited at different current densities and constant temperature: 5 mA/cm²: floe like microstructure; 26mA/cm²: tapered shape microstructure → higher current densities results in cubic, tapered shape Al grains

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Fraunhofer ENAS

First Day – Tuesday June 14, 2016

Time		Speaker	Company	Titel
from	to			
1:00	1:20	M. Wiemer	Fraunhofer ENAS	Welcome note, Introduction to ENAS and Department System packaging
1:20	1:50	Prof. Jong Min Kim	University of Cambridge	Nanotechnology for its Convergence and Applications
1:50	2:20	Dr. Martin Eibelhuber	Dr. Martin Eibelhuber, EV Group E. Thallner GmbH	Developments, Applications and Challenges for the Industrial Implementation of Nanoimprinting Lithography
2:20	2:50	Dr. Wei-Shan Wang	Fraunhofer ENAS	Vertically-integrated array-type miniature interferometer as a core optical component of a coherence tomography system for tissue inspection
2:50	3:20	Tilo Borchardt	Tilo Borchardt, GETEMED Medizin- und Informationstechnik AG	Mobile Medical Devices for the Internet of Things – Design Challenges
3:20	3:50	Coffee break and networking		
3:50	4:20	Jens Heese	Jens Heese, Hansaton Akustik GmbH	Actual Hearing Aid Technologies – Technical innovations on smallest space
4:20	4:50	Dr. Tobias Liese	Siegert Thinfilm Technology	NiC: a new functional layer with high sensitivity for pressure and force sensors
4:50	5:20	Ronny Neubert	Microsensys	Separation of SiC Wafer Using Thermal Laser Separation
5:20	5:40	Dr. Reza Bahmanyar	Imperial College London	Implantable Pressure Sensors

Second Day – Wednesday June 15, 2016

Time		Speaker	Company	Titel
from	to			
09:00	09:10	M. Wiemer	Fraunhofer ENAS	Welcome
09:10	09:40	Dirk Wünsch	Fraunhofer ENAS	Temporary Wafer Bonding – Key technology for 3D MEMS Integration
09:40	10:10	Dr. Steffen Kröhnert	NANIUM S.A.	Beyond State-of-the-Art: Integration of MEMS in Fan-Out Wafer-Level Packaging Technology based System-in-Package (WLSiP)
10:10	10:40	Dr. Srdjan Krco	DUNAV NET	TagItSmart - Creating IoT for mass market products
10:40	11:10	Frank Roscher	Fraunhofer ENAS	Printing of Electrical Functional Structures by using Aerosol-Jet
11:10	11:40	Coffee break		
11:40	12:10	Sebastian Hahn	PacTech – Packaging Technologies GmbH	Solder Jetting, Rework & Electroless UBM Deposition Made in Germany
12:10	12:40	Maaike M. Visser Taklo	SINTEF ICT Instrumentation Dept.	Soldering of MEMS and Silicon Interposers: The Role of Intermetallic Compounds
12:40	1:10	Dr. Matthias Domke	Microtech Gefell GmbH	Design and Applications of Linear Microphone Arrays
1:10	1:40	Pieter Vandewalle	KLA-Tencor GmbH	How Can Process Control Help to Increase Yield for Advanced Packages like WLCSP, SIP, FO-WLP?
1:40				Closing remarks and lunch

Contact us

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