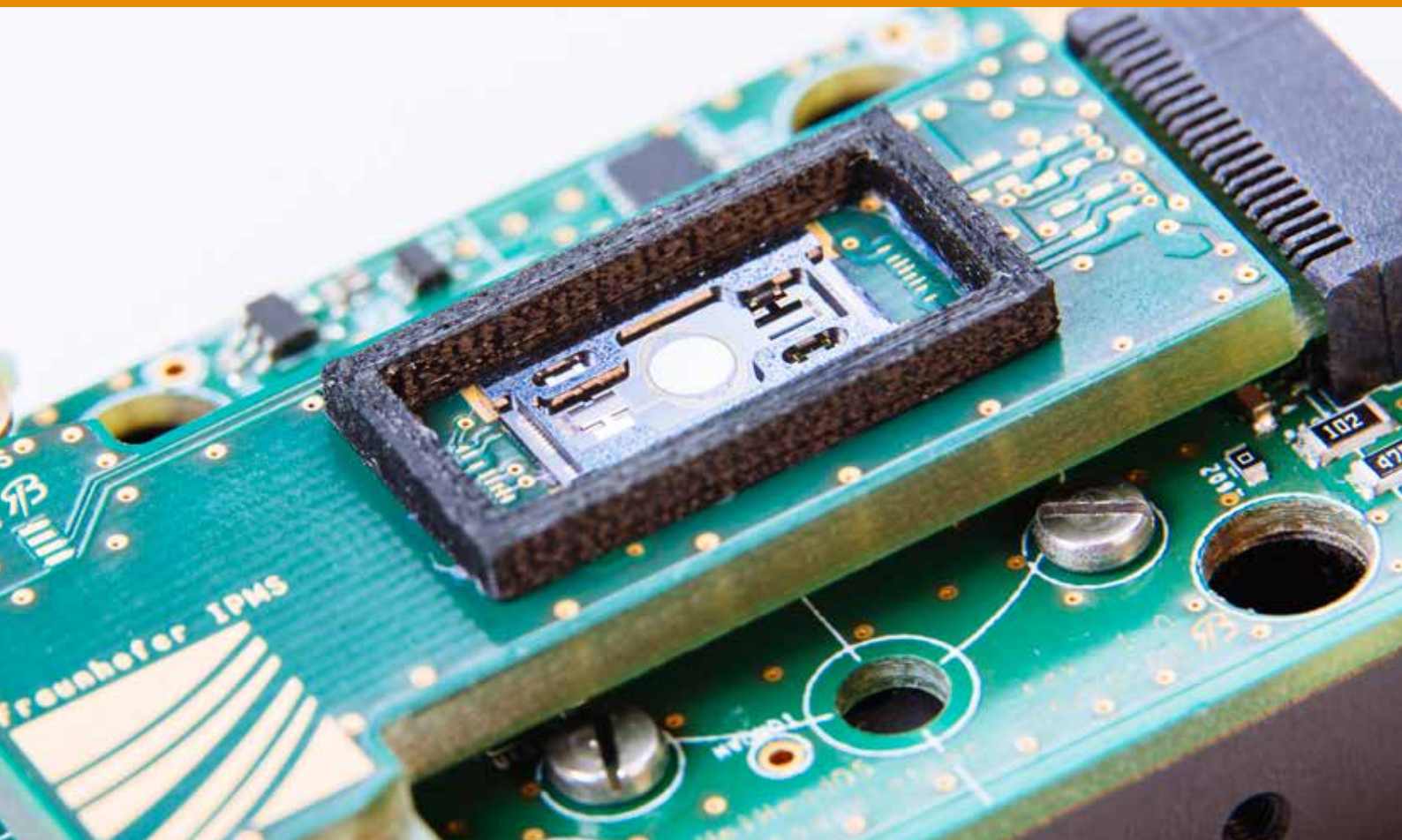


MEMS REPORT

4 / 2016



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Dear Customers, Partners and Friends
of Fraunhofer IPMS,

On September 21, 2016 the official opening event marking the extension of our microsystem cleanroom to a 200 mm process line took place in the presence of honored guests including Dr. Eva-Maria Stange, Saxonian Minister of Science and Art, Dirk Hilbert, Mayor of Dresden and numerous guests from the fields of politics, business and science. Because of investment totaling 30 million Euro, for which we thank the state and federal governments as well as the EU, we can now provide infrastructure according to the current industry standard with modern, reliable and networkable plants. This yields new possibilities for access to cutting-edge microsystem technology, the integration of new materials and, therefore, the development of new sensors and other components which external partners can then monolithically integrate into 200 mm CMOS wafers. Already existing collaborations such as those underway in the combined Fraunhofer Group for Microelectronics and Fraunhofer High Performance Center Micro/Nano, the ADMONT project and with regional partners can thus be maintained and extended. We are therefore making an important R&D contribution to the technological excellence and respected image of the "Silicon Saxony" location. We wish you informative reading with this current MEMS report.



Prof. Dr. Harald Schenk

Prof. Dr. Hubert Lakner

FRAUNHOFER IPMS TOOK PART IN GERMAN UNIFICATION CELEBRATIONS IN DRESDEN

This year's central festivities celebrating German Unification were held in the state of Saxony. Among the many attractions, Dresden hosted a citizen festival in the heart of the city from Oct 1-3, 2016. The Fraunhofer Institutes of Saxony were presented at the festival's Science Mile in a joint pavilion entitled "Fraunhofer in Saxony – Experiencing Research Close Up". Representatives from the local Fraunhofer IPMS introduced a variety of micro-electronic-mechanical systems applications to a large audience and demonstrated how multi-faceted, value-adding and exciting research can be.



Johannes Kade of Fraunhofer IPMS (left) with Thomas Schmidt, State Minister for Environment and Agriculture, and Aline Fiedler, Member of the Saxon State Parliament.

CNT INDUSTRY PARTNER DAY

Once a year, the Center for Nanoelectronic Technologies (Fraunhofer IPMS-CNT) presents the latest developments in the fields of high-k devices, non-volatile memories, interconnects and MEMS. Scientists from the Fraunhofer IPMS and external industry partners have provided information about current projects, developments and future outlooks on Nov 3, 2016.

CNT
INDUSTRY
PARTNER DAY

November 3, 2016



CLEVERLY PACKAGED, INTELLIGENTLY PROTECTED: MAGIC RFID FORMULA FOR THE PACKAGING INDUSTRY

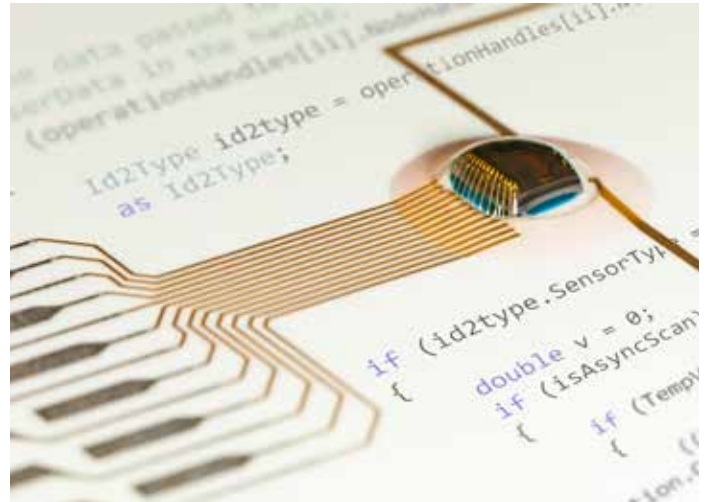
With its ROAD-server, Fraunhofer IPMS provides an easy solution to combine the wireless and optical identification of packaging. The Dresden-based research institute first introduced this universal software solution with a demonstration at FachPack 2016 in Nuremberg.

Intelligent packaging is on the rise. The implementation of RFID technology in the packaging industry is becoming increasingly important especially in terms of information, identification and security. Although it is easy to identify packages and their contents, read product information and to provide verification and evaluation, things become difficult when various RFID components from different manufacturers are left to communicate with each other. In cases in which these components require further integration with optical identification methods such as barcode reader systems, users are faced with substantial complexity, extensive implementation times and considerable cost.



With its ROAD-server, Fraunhofer IPMS provides an easy solution to combine the wireless and optical identification of packaging.

The Fraunhofer IPMS has therefore developed the universal RFID-OPC-UA-AutoID Server (ROAD-server) software solution. This middleware provides for easy and cost efficient integration of various readers, tags and sensor technology in complex process environments regardless of manufacturer, frequency band, protocol and interface. As the first middleware of its kind, the ROAD-server implements the OPC UA (unified Architecture Open Platform Communication) AutoID companion specification to provide manufacturer-independent communication in automation technology.



The ROAD-server works like an universal adapter and makes it much easier to integrate RFID technology into intelligent production environments.

Initially used only for RFID components, the Dresden-based research team led by Professor Dr. Dirk Reichelt has now extended the ROAD-server to include the integration of 1D- and 2D barcode technologies. When implemented on the OPC-UA interface basis, applications can be further used regardless of changes to the reader- or transponder-population.

Prof. Dr. Reichelt, Fraunhofer IPMS Group Leader for Smart Wireless Production explains: "This is of particularly great interest for the packaging industry. Our software solution enables the easy combination of wireless and optical identification methods. Regardless whether a packet or shipping crate carries a barcode or an RFID-tag, standard reader devices and tags for various frequency ranges can connect and communicate with each other in process constructions over a single standardized interface through the ROAD-server. Integration of further sensor-transponders for reporting physical parameters such as temperature, moisture, light or pressure is also possible."

Transporting food, medicines or hazardous materials must be rigorously controlled. Moisture and high temperatures inside shipping crates can result in quality deterioration and product decay as well as dangerous situations. Sensor values can be wirelessly read and product characteristics can be examined quickly and safely over integrated RFID-tags without opening the packaging. The integration of additional sensors detecting, for example, limit values is also conceivable.

REALTIME LI-FI FOR INDUSTRIE 4.0



A team at the Fraunhofer IPMS has developed a Li-Fi communication module that allows wireless networking of devices that are used in industrial production. The optical transmission technology not only facilitates the exchange of huge amounts of data, but also meets the high real-time characteristics of automation technology. The technology is intended to supplement or replace wired fieldbus or Ethernet systems prone to wear and tear.

Industrie 4.0 has already been introduced in many companies. In the "intelligent factories" of tomorrow, processes will be fully automated and manufacturing and logistics will become increasingly computerized. Therefore, more and more sensors, machines and control units must communicate with each other, which in turn leads to high amounts of data needing to be transferred. Moreover, the need for communication between intelligent automation systems, especially in the control and sensor/actuator field will become increasingly time-critical. Many cases will require the communication system and data transmission cycle times to be synchronized at a tact of less than one millisecond. To meet these growing challenges of industrial networks, companies have long tended to replace or supplement slow communication links existing in the field of production and process automation with

Ethernet-based and real-time fieldbus systems. However, the available, so-called industrial Ethernet systems are wired and unable to function without expensive, wear-prone connections, special cables or slip rings. Installing a signal cable from the sensors or actuators to the control unit is often found to be very expensive or even impossible, particularly in mobile or moving system components such as gripper arms or lifting devices. The Fraunhofer IPMS Li-Fi communication module, named "GigaDock", provides substantial advantages in such situations. "Our GigaDock uses the available regulatory-free spectrum of light with a bandwidth up to 12.5 gigabits per second. That's 10 times faster than current wireless solutions such as WLAN, Bluetooth or ZigBee," explains Project Manager Dr. Alexander Noack. "We were able to achieve very good real-time characteristics at distances of up to 50 mm and demonstrate latency values of less than one millisecond." The driverless transmitter/receiver modules combine an optical transceiver and a protocol controller with a Gigabit Ethernet interface and can thus be easily integrated into industry-standard systems. At the 2016 ECOC, Europe's largest conference and exhibition for optical communications, developers from the Fraunhofer IPMS presented the GigaDock communication module along with other Li-Fi demonstrators for greater distances of up to 10 meters. Fraunhofer IPMS provides individual customer evaluation kits for the testing of its Li-Fi technology for different fields of application.

EVALUATION KIT FOR QUASI-STATIC MEMS SCANNERS



With its ResoLin Evaluation Kit called “QSDrive Scan Kit”, the Fraunhofer IPMS in Dresden now offers clients the opportunity for cost-effective and flexible testing of quasi statically-deflectable MEMS-scanning mirrors for applications that so far could not be satisfactorily implemented with commonly used resonant micro-scanners.

A variety of applications used for image capture and projection, spectroscopy and 3D measurement technology invoke the principle of light deflection. Micromechanically-manufactured, one- or two-axis movable scanner mirrors are the preferred technology for applications with high demands of robustness, energy efficiency and overall size. Fraunhofer IPMS ResoLin scanner technology builds upon the manufacturing technology for resonant micro-scanners developed at the institute. The concept is to sustainably tilt the drive combs of the resonant scanners already in place toward each other, thereby allowing a linear drive of the mirror plate in one axis. Furthermore, a resonant drive with a defined frequency in the fast, horizontal axis can be combined with a variable quasi-static deflection on the vertical axis for a projector. Dr. Markus Schwarzenberg, head of the Fraunhofer IPMS research group strongly believes in the potential of the component concept: “Our ResoLin scanner technology provides new possibilities for laser scanning

and projection. It can be quickly shifted between targeted positions of the laser beam and it is also possible to dynamically adjust scanning speed. 3D cameras or miniaturized laser projectors so equipped offer higher resolution and make solutions long dreamed of, such as sharp robot eyes or compact hand-held projectors with high image quality, possible.”

Now available, the “QSDrive Scan Kit” evaluation kit particularly appeals to small and mid-sized companies unable to afford in-house development. The kit is comprised of a ResoLin component (a cardanic MEMS scanner with a linear axis and an optional, orthogonally-oriented resonant axis) as well as control electronics to operate components with an optimized trajectory. A scanning head, which due to its special design can be easily integrated into popular optical test setups, is included. Controlled operation as well as the synchronized operation of the resonant axis are possible according to the specific design of the MEMS component. Function control is provided by software over a USB interface.

Developers from the Fraunhofer IPMS presented the ResoLin evaluation kit to the public for the first time at Vision 2016, the world’s leading trade fair for image processing.

FRAUNHOFER IPMS MICROSYSTEMS CLEAN ROOM EXTENDS TO 200 MM PROCESS LINE

In a celebratory event, Fraunhofer IPMS officially launched the extension of its microsystem clean room to a 200 mm process line in front of an audience including Dr. Eva-Maria Stange, Saxony's Minister for Science and Art, Dresden's Lord Mayor Dirk Hilbert and guests from science, business and politics. Besides wafers with 150 mm diameter, this extension enables the Institute to process wafers 200 mm in diameter commonly used in industrial applications of microsystem technology.

Dr. Eva-Maria Stange symbolically commissioned one of the first newly-installed systems and personally wished Fraunhofer IPMS and its partners much success, "With its highly motivated and dedicated team, Fraunhofer IPMS is one of the world's foremost pioneers in the research and development of novel, highly-integrated functional microsystems. The Free State of Saxony supports the 200 mm extension with 24 million Euro from resources coming from both the state and European funds for regional development. The money is well spent, as these funds enable Fraunhofer IPMS to successfully continue its future-oriented research and maintain its position as a pioneer and innovation leader."



Official opening of the 200 mm extension at Fraunhofer IPMS (f.l.t.r. Prof. Dr. Harald Schenk, Dr. Eva-Maria Stange, Prof. Dr. Hubert Lakner).

Prof. Hubert Lakner and Prof. Harald Schenk, Fraunhofer IPMS institute directors, consider the 200 mm wafer format extension prerequisite for the continuation of working at the highest levels with business and industry partners. Harald Schenk stressed, "Our

most important research and development partners have already transitioned to 200 mm technology. We are grateful to our state and federal governments as well as the EU for support totaling 30 million Euro. The 200 mm extension of our process line positions us to continue to be technologically compatible with our industrial partners in order to achieve further miniaturization and functional integration as well as to put solutions in the field of microsystem technology into application."

Dr. Jens Kosch, CTO of X-FAB Semiconductor Foundries AG defined the transition as a necessary step for the industry, saying in his lecture, "Fraunhofer IPMS is an important development partner for X-FAB. Alignment of the wafer format provides new possibilities in the distribution of wafer processing work, as how we have already begun in the ECSEL-funded ADMONT project."

The extension of facilities and processes at Fraunhofer IPMS is part of a series of measures being taken by the Saxon government to intensify cooperation between research and industry with the aim of strengthening the Saxony microelectronics location. The Free State of Saxony is for instance supporting the Fraunhofer High Performance Center "Functional Integration for Micro- and Nanoelectronics", with Fraunhofer IPMS playing a key role and serving as coordinator, with a total of 5 million Euro between 2015 and 2017. The 200 mm extension will be used to adapt existing supply unit infrastructure as well as to convert plants and processes and furnish new systems. According to Fraunhofer IPMS, the overall extension project will be completed in 2018.

VON ARDENNE Supplies Fraunhofer IPMS with Cluster System for MEMS Fabrication

The Fraunhofer IPMS has placed an order with VON ARDENNE for a new cluster sputter system CS400S for the deposition of thin films. The investment is part of the extension of the clean room of the Dresden-based institute to accommodate the 200 mm wafer technology. By installing the CS400S, Fraunhofer IPMS and VON ARDENNE seek to advance the development and production of highly reflective layer systems for micro-(opto)-electro-mechanical systems, the so-called MEMS and MOEMS.

This CS400S is one of the largest cluster systems that VON ARDENNE has built so far. It consists of two magazine load lock

chambers, one pre-treatment chamber and five process chambers. The chambers are grouped around a central handling unit with an integrated alignment station. The cluster design of the system enables the sequential in situ deposition of several layers, without the necessity to remove the substrate from the vacuum.



VON ARDENNE Cluster Sputter System CS400S.

VON ARDENNE has managed to prevail against some renowned competitors during the bidding process. "Two factors were critical for our decision", said Dr. Matthias Schulze, head of the engineering department at Fraunhofer IPMS. "On the one hand, we are already using VON ARDENNE equipment for the coating of 150 millimeter wafers. Given the many years of good cooperation and shared experiences, we expect the CS400S to be an excellent system. On the other hand, this tool offers the greatest flexibility for the development of new processes for MEMS and MOEMS applications", he continued. "The new machine platform combined with the strategic partnership with VON ARDENNE are key success factors for the sustainable expansion of our R&D and pilot fabrication activities", said Prof. Dr. Harald Schenk, director of the Fraunhofer IPMS.

Fraunhofer IPMS and VON ARDENNE plan to establish a close cooperation so that both parties can develop more applications for industrial use and make them marketable. This can either be done in cooperation with each other or together with customers. Thanks to the expertise of both partners and the flexibility of the sputter system, it will be easy to adjust it to new requirements.

UPCOMING EVENTS

VISION

Stuttgart, Germany November 8 - 10, 2016
Stuttgart Exhibition Center, Booth 1H75

Electronica

Munich, Germany November 8 - 11, 2016
München Exhibition Center, Hall A4, Booth 113

sps ipc drives

Nuremberg, Germany November 22 - 24, 2016
Nuremberg Exhibition Center, Booth 2-500

SPIE Photonics West

San Francisco, USA January 31 - February 2, 2017
The Moscone Center, Booth 4324

Smart Systems Integration

Cork, Ireland March 8 - 9, 2017
Radisson BLU Hotel & Spa, Cork

www.ipms.fraunhofer.de/en/events.html

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