

CIXA

# Driving innovations Setting standards



Stephan Tiedke CEO aixACCT Sytem

### Dear Customer,

For more than two decades we have been working in the field of piezo electric materials and creating outstanding characterization systems, which are always beyond the state of the art.

What motivates us: We are doing things that others can not do.

The market of ferroelectric characterization was essentially dominated by an established competitor, but because we are rethinking existing technologies and are constantly growing to meet our challenges, we have made it to the top.

On the following pages we would like to show you some highlights which not only guarantee the success of aixACCT, but also enable our customers to successfully develop their products.

Sincerely yours,



1995

Founded as

a government

project

### History of aixACCT Systems



First ferro electric test system (FeRam)

2002

Delivery of first piezoelectric test systems for bulk materials (PES)



Delivery of first DBLI System

2017

Delivery of 28. DBLI System Delivery of 150. PES Systems and customized test systems 2014 World leader in testing Piezo electrics

2019

Introduction of first production tool for piezo bulk materials

2020 New business unit aixACCT TMC Tools Measurments Consulting

# History of

	1997	Static hysteresis measurement
1997 Static hysteresis	1998	Fast pulse switching testing, equal in speed to real operation frequency of a FeRAM
	1999	Hysteresis measurement on pad sizes down to 1 $\mu m$ x 1 $\mu m$
2001 World record 00nm x200nm	2000	First direct hysteresis measurement on real FeRAM memory cell capacitor Kinetics investigation by Pulse switching test
measurement	2001	First published direct hysteresis measurement on 200 nm x 200 nm ferroelectric capacitor structures
		Hysteresis measurement at 1 MHz and 10 MHz by virtual ground testing of 1T1C memory cells
2005 Patent on DLLC method	2003	World first measurements on single cell testing on wafer level after full integration on 32 MBit chain FeRAM
	2005	Patent and implementation of a new dynamic leakage current compensation method (DLCC)

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### innovations

**2006** Unique and patented sample holder for thin film e<sub>31,f</sub> piezocoefficient measurements utilizing 4-point bending technique

d33,f measurement with sub picometer resolution

Byer Rounds Pyroelectric Testing

- **2007** Introducing CMA system for characterization of multilayer acutators for e.g. fine positioning as well as for fuel injection systems. The tool can derive figure of merit of an actuator under a wide temperature range
- 2008 Piezoelectric Transducer Test Bench for comprehensive characterization of bulk materials and multilayer actuators with mechanical prestress. Sensors and actuators and harvester can be characterized!
- 2009 d<sub>15</sub> option for bulk materials including pulse test (pulse width 10µs) into aixPES technologie
- 2010 Impedance measurement implemented TF Analyzer Displacement vs frequenz implemented into aixPES system

2006 First 4PB System Patent



2010 Impedance measurements

# History of

	2011	Single beam functionality integrated into DBLI technology
2012 μCMA System		Long Term stability of DBLI technology demonstrated (better 0,5 % without any adjustment of optics)
	2012	Blocking Force Measurement for piezoelectronic MEMS
		Contact restistance vs. contact force on 8 Wafers
		Electrocaloric measurement
2013	2013	Multiferroic Test system
PSHU kryo		High temperature sample holder for Multiferroics Test system
		e <sub>31,f</sub> vs. bias voltage
		High temperature (600°C) and low temperature (-100°C) sample holder for piezoelectric bulk materials
2014	2014	e <sub>31</sub> on full wafer utilizing DBLI technology
e31,† neasurement		world first temperature measurements with DBLI
on full wafer		Electronic measurement system
		Thermoelectric measurement system

### innovations



2016 Thermoelectric characterization LTT coefficient transformation

2018 Thermal stimulated current DBLI measurements with small spot size down to 2μm high side current measurement for Polaron systems Introduction of MIT Multi Item Testbench software tool

- 2019Localized pyroelectric measurementIntroduction of AUA Automation Assisitant software platform
- 2020 Thermoreflectance measurement
  DLTS

Introduction of DCA Defect chemistry Analyzer



2015 HALT test systems



2020 DCA Defect Chemistry Analyzer

### **Evolution of aixA**

1999 FeRAM cell capaitor testing

#### World record in resolution

First measurements on a single cell capacitors with an electrode size of less than 200nm.







### Rt-> 250°C measurements

First PES system that was developed in order to measure the temperature dependency of piezoelectric properties of bulk ceramics fully automated.





2005 First DBLI System

#### First d<sub>33,f</sub> measurement on 6 inch wafer

First commercial DBLI system that was able to measure  $d_{33,f}$  of a clamped thin film on 6 inch wafers. The system performs measurements for wafer mapping with an accuracy of better than 1% sigma.









## **CCT** innovations



#### Ultra fast pulse switching

aixACCT integrated a system into a cluster tool to apply ultra short voltage pulses. It allows the characterization of memory cells at frequencies of more than 100 MHz.

2011 Integrated Cluster tool



### -100°C to 600 °C measurements

First PES system with Kryo sample holder that is able to measure piezoelectric properties of bulk ceramics fully automated in a unique temperature range. 2013 Kryo PES System



#### Fully automated 8 inch DBLI

First 8 inch DBLI tool that was fully automated. It is equipped with wafer robot that allows a full integration in the fab for production control.

2008 First 8 inch DBLI System

### **Evolution of aixA**

2006 First CMA test system

#### First CMA for Fuel injector testing

First System that was able to apply forces to a test sample in order to measure the blocking force.







#### **Development of first 4BP**

We have realized a 4 point bending system to measure the direct  $e_{31,f}$  of PZT thin film materials with a unique accuracy. Advantage against other measurement set-ups is a homogeneous and well defined tensile stress distribution in the piezoelectric film layer.





2001 System with switch matrix

#### Integration of switch matrix

aixACCT integrated the control of commercial switch matrix system. This allows multiple sample testing





## **CCT** innovations





#### µCMA test system

In addition to the continuous improvements of the basic CMA we have developed a system for testing ultra small actuators that are used in hard disk drive industry for example. 2012 µCMA System



### Temperature option and indirect e<sub>31,f</sub>

Due to the increasing number of various applications we enhance the characterization of  $e_{31,f}$  under different environmental conditions. This includes a new large signal measurement method using the Kanno/Muralt principle, which is upgradeable on our thin film sample holders.

2015 enhanced e31 test System





### Parallel test system

The system is designed for fast reliability and accelerated life testing of piezoelectric or dielectric materials. A large number of samples can be connected and scanned via an integrated switching matrix used for dielectric breakdown (TDDB) studies as well as fatigue cycling stress tests. The latest development are our Polaron tools that are use for production purposes. 2016 HALT Test System 2019 Polaron

### **SUCCESS Stories**



Our DBLI tool allowed to measure the d33,f distribution across the wafer at a very early process stage. Only depositing and structuring of top electrode layer was necessary. The result of the measurement was surprising. The d33 value even changed its sign from positive to negative from the center to the edge of the wafer. This behavior was not expected, as several other characterization like rocking curve showing a nice and homogeneous film growth.

It appears that the residual stress was the reason for this phenomena and the problem could be solved within a very short time.

With the DBLI technology we were able to optimize our process to 1% homogeneity within six month.

Lead engineer, Seagate Technologies, HDD-Industry, USA







# **U**»SOUND

USound GmbH is a fast growing audio start-up, founded with the mission of developing and producing the most advanced audio systems for mobile applications based on MEMS technology. The technological platform developed by USound is enabling the production of a revolutionary generation of MEMS micro speakers that will be deployed in the world's top mobile applications.

aixACCT supports the development of innovative loudspeaker systems. In addition to studies on the polarization and deflection of the MEMS devices, stiffness and blocking force studies were also performed on membranes. This gives valuable insights which influences the simulation and design of new products. In addition, aixACCT is doing the life-cycle analyses, which are essential for a successful product launch.

"With aixACCT we have found a reliable partner for characterizations from the prototype to the product. This helps us in our fast and goal-oriented product development" CTO Andrea Rusconi









## **SUCCESS Story**



Xaar develops world-leading piezoelectric drop-on-demand inkjet technologies. They are also a world-class manufacturer of industrial digital inkjet print heads

We are supporting XAAR with full branch of test equipment reaching from thin film characterization to device test system for print heads.

In cooperation with XAAR we have worked on latest research allowing the prediction of pad size dependency of DBLI measurements and extraction of  $e_{31,f}$  coefficients form pure DBLI measurements.







### Projects

Over the last year we have been participating in a large number of EU, national and industry projects.

Where we contribute with our measurement technology to help developing path breaking technologies.







Top-Innovator 2015