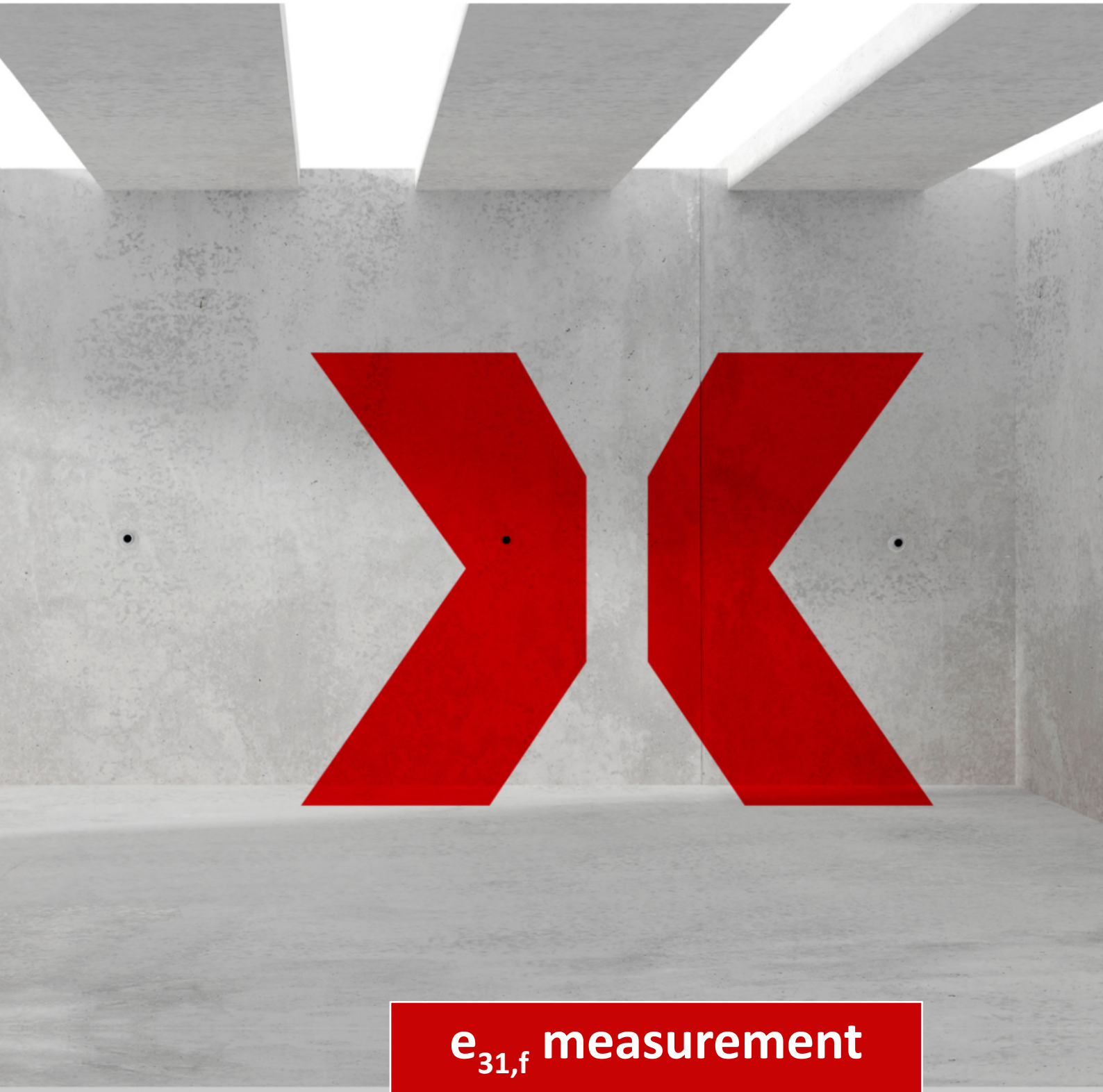
aixACCT systems



$e_{31,f}$ measurement with aixACCT Systems

$e_{31,f}$ coefficient

The $e_{31,f}$ coefficient is one of the most important parameters for qualification of the piezoelectric performance of thin film materials and its behavior in multiple applications.

Since 2006 aixACCT has offered a system solution that is able to measure this parameter using a patent four point bending method.

Due to the increasing number of various applications aixACCT follows our customers requests to characterize the $e_{31,f}$ under different environmental conditions.

This includes a new large signal measurement method using the Kanno/ Muralt principle, which is upgradable on our thin film sample holders.

New $e_{31,f}$ measurement features

Bias dependent measurements

Automated measurement of bias dependency of $e_{31,f}$ using direct mode

Temperature dependent measurements

Sample heating up to 200°C for all measurement methods

Large signal $e_{31,ls}$

Inverse method using Kanno/Muralt method

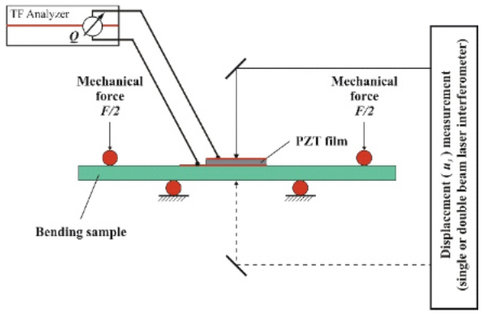
$e_{31,f}$ out of d_{33}

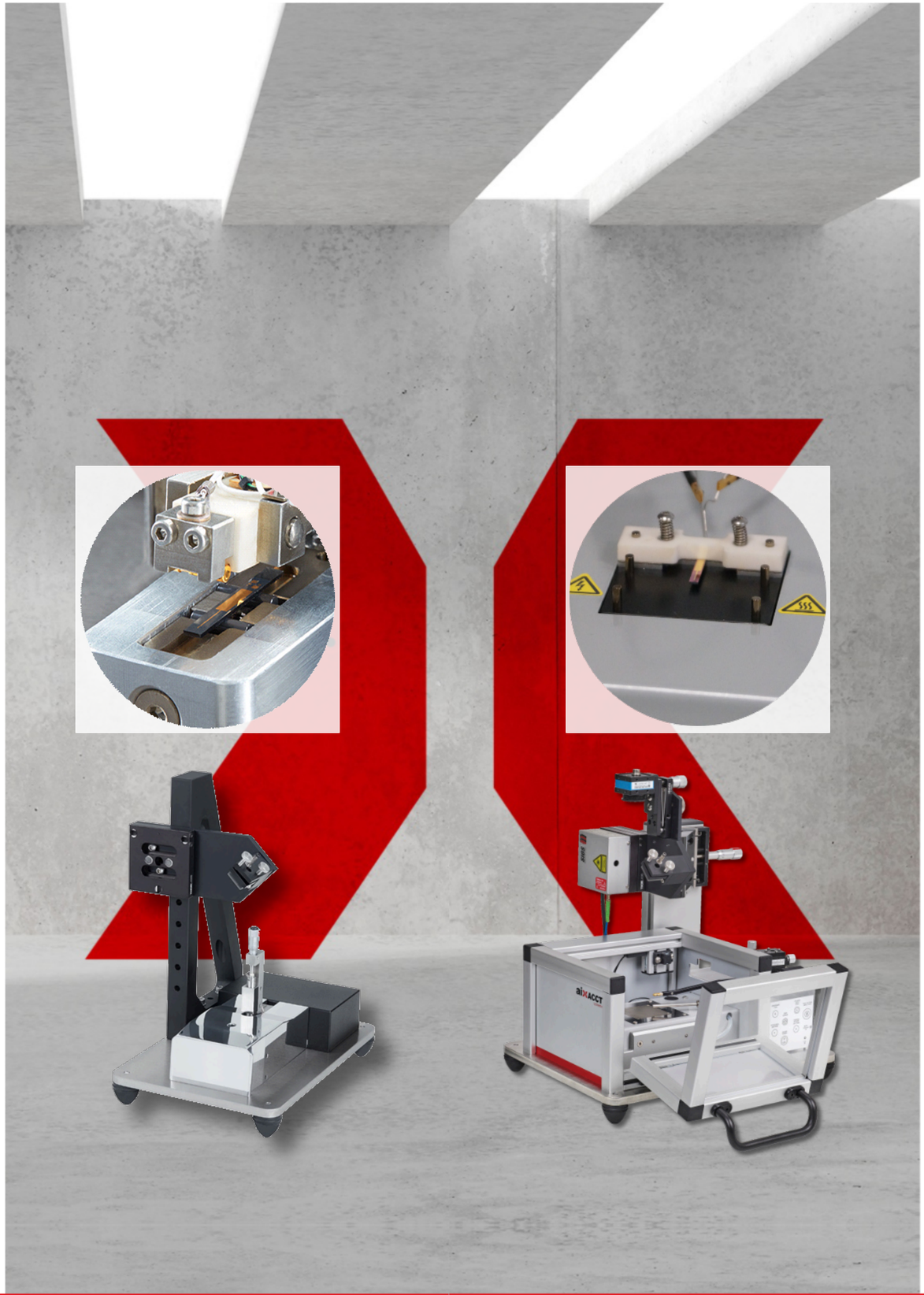
Determination of $e_{31,f}$ on full wafer using DBLI technology

aix4PB – direct effect

The aix4PB measurement system utilizes a modified 4-point bending set up. This innovative set-up allows the application of homogeneous, well defined mechanical stresses to the thin film, which guarantees a precise extraction of the piezoelectric coefficient with well defined boundary conditions.

This setup is now enhanced by heating system which allows temperature dependent measurements. New automated functions allows now the measurement of electrical or mechanical fatigue. The integrated amplifier is able to apply DC Bias voltages up to +/- 60V.





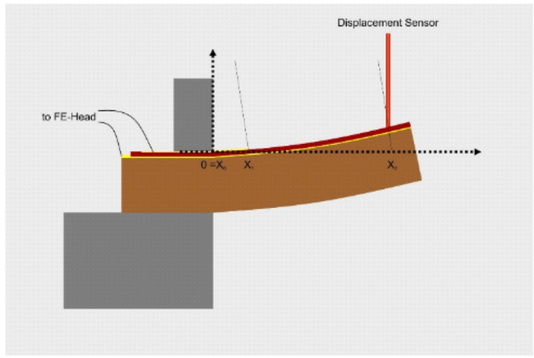
TFSHU_e_{31}extension – indirect effect

The TFSHU for thin films and mems characterization was extended with a mounting fixture for diced thin film cantilever.

It is based on considerations of Kanno and Muralt*. Contrary to the direct method the sample will be fixed only at one end and an electrical field will be applied to the piezoelectric active material.

This allows the measurement of the $e_{31,f}$ using the indirect method. This large signal excitation is related to actuator applications. Furthermore the setup allows the investigation of temperature and/or fatigue dependency.

*I. Kanno et al. / Sensors and Actuators A 107 (2003) 68-74, M.-A. Dubios and P. Muralt, Sens. Actuators 77, 106 (1999)



aixDBLI – e_{31} on waferlevel

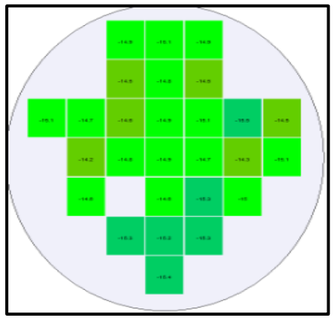
The investigation of the dependency between pad size, wafer thickness and d_{33} lead to the idea of determination of e_{31} using two measurements on different pad sizes.

$$e_{31,f} = \frac{d_{33,meas1} - d_{33,meas2}}{f(r_1) - f(r_2)} \cdot \frac{Y_{Si}}{2v_{Si}}$$

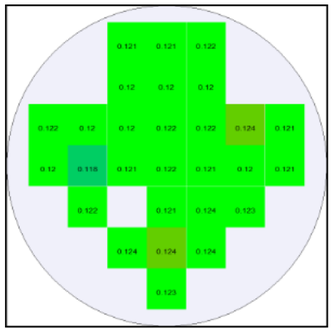
$$d_{33,f} = \frac{f(r_1) \cdot d_{33,meas2} - f(r_2) \cdot d_{33,meas1}}{f(r_1) - f(r_2)}$$

Now aixACCT offers a solution to derive these parameters automatically with our DBLI tools and allows a precise determination of $e_{31,f}$ without wafer dicing for the first time.

$e_{31,f}$ distribution



$d_{33,f}$ distribution



Specification

aix4PB

Maximum voltage for actuator
-30 V to +150 V
Maximum sample voltage 400 V
Bias Voltage (internal) +/-60V
Max. sample deflection approx. 400 µm (sample dependent)
Temperature range RT to 200°C
Laser Resolution 0,3nm
Accuracy e31,f 0,03C/m² sigma over mean on AlN

Possible measurements e31 direct, fatigue, thermo, eakage, dynamic hysteresis

e31LTT (aixDBLI)

Maximum sample voltage 400 V
Temperature range only RT
Resolution 0,5 pm
Deviation e31,f 2,5% sigma over mean

Please contact us for more detailed information!

TFSHU enhanced

Maximum sample voltage 500 V
Max. sample deflection approx. 400 µm (sample dependent)
Temperature range RT to 200°C
Laser Resolution 0,3nm
Accuracy displacement 5nm sigma over mean

Possible measurements e31 indirect, fatigue, thermo, leakage, dynamic hysteresis, etc

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