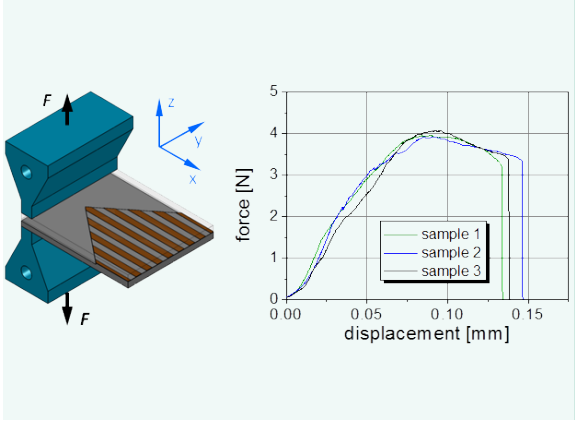
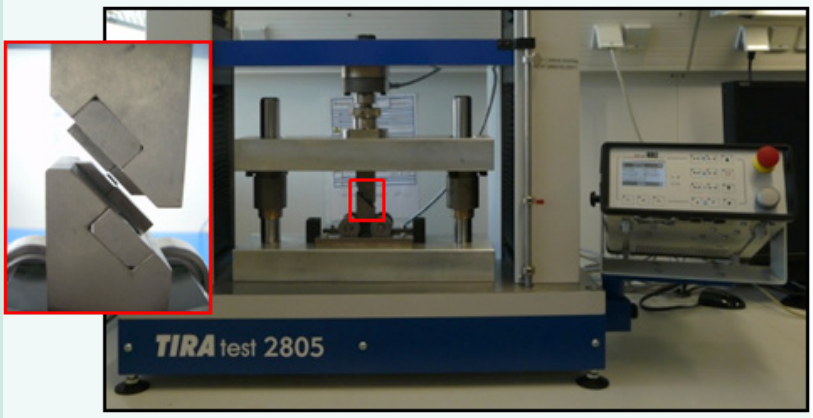
MECHANICAL CHARACTERIZATION OF THE BONDING STRENGTH





Contact

Fraunhofer Institute for Electronic Nano Systems ENAS
Technologie-Campus 3
09126 Chemnitz | Germany

Contact person
Dr. Maik Wiemer
Phone: +49 371 45001-233
E-mail: maik.wiemer@enas.fraunhofer.de

Klaus Vogel
Phone: +49 371 45001-298
E-mail: klaus.vogel@enas.fraunhofer.de

Description

Waferbonding is a key technology for the development of new Microsystems. To ensure the functionality of the micro electromechanical systems (MEMS) and nano electromechanical systems (NEMS), a mechanically strong and hermetically sealed package is required. The reliability of the MEMS devices is mainly affected by the bonded interface. Therefore, the determination of the mechanical properties of the bonded interface is essential for the design of new micro and nano systems as well as the life time assessment.
For the analysis of the bonding strength, the Fraunhofer ENAS specialized on the Micro Chevron test and the compression shear test. Based on a mode I crack opening, the Micro Chevron test represents the most critical failure mechanism for MEMS and NEMS devices. It is used to determine the fracture toughness and energy release rate. The compression shear test is a suitable approach to characterize the shear strength of packages with a medium or high mismatch in the coefficients of thermal expansion. The shear test can be carried out with fully processed micro systems and therefore enables the analysis of real devices.

Advantages of the test methods

- Evaluation of packages bonded with and without intermediate layers
- Analysis of different bonding parameters on the bonding strength
- Characterization of the homogeneity of the bonding process
- Assessment of fully processed devices based on the compression shear test

Fraunhofer ENAS
ZfM Zentrum für Mikrotechnologien
TECHNISCHE UNIVERSITÄT CHEMNITZ

	Micro Chevron test	Compression shear test
Bonding Strength	fracture toughness K_{IC} energy release rate G_{IC}	shear strength τ_{shear}
Substrates	same material	different materials
Process	with and without intermediate layers	with and without intermediate layers
Accuracy	high	medium
Scatter of results	small	medium
Sample length	$l \geq 5$ mm	$l \leq 10$ mm
Sample width	5 mm $\leq w \leq$ 10 mm	$w \leq 10$ mm
Substrate thickness	$d \leq 675$ µm	50 µm, 100 µm, 200 µm, 300 µm, 400 µm, 450 µm, 500 µm, 600 µm
	special designs of the specimens on request	
Test speed	$v \geq 1$ µm/s	$v \geq 0{,}01$ mm/min
Maximum force	$F_{max} \leq 80$ N	$F_{max} \leq 5000$ N
Additional offers	numerical determination of the stress intensity coefficient for special sample designs	

Figures:
page 1: Schematics of Micro-Chevron-Test with measured force-displacment-curve for glassfrit bonded test samples (left);
Compression shear test based on a universal testing machine TIRA test 2805 (TIRA GmbH) for an anodic bonded silicon-glass-sample (right)

Photo acknowledgments:
Fraunhofer ENAS

Fraunhofer ENAS
ZfM Zentrum für Mikrotechnologien
TECHNISCHE UNIVERSITÄT CHEMNITZ