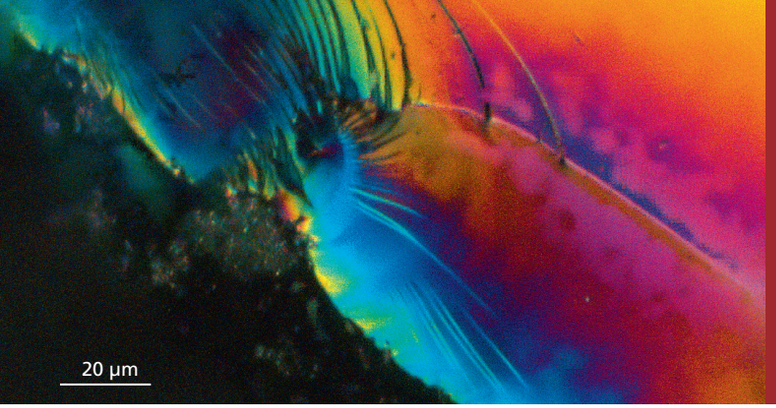


Cause of fracture in automotive glass.

FRAUNHOFER INSTITUTE FOR
MECHANICS OF MATERIALS IWM

Application examples

Fraunhofer IWM has decades of experience in investigating failure in brittle materials such as glass and silicon and we enjoy a close, trusting relationship with our clients. Our methodological approach to damage analysis results frequently in improvements, new developments, and increased product safety.

Materials

- Float glass
- VSG, ESG, TVG
- Technical glass types
- Quartz glass
- Domestic glass
- Glass ceramics

Processes

- Machining processes (sawing, sanding, polishing)
- Etching, coating
- Soldering, laminating
- Printing, sintering
- Handling

Components

- Automotive glazing (ESG and VSG, e.g. sunroof, front and rear windscreen)
- Printed and finished glass components (e.g. glass partition walls in buildings)
- Optical lenses (e.g. IR lenses)
- Silicon wafers, solar cells, solar modules
- Microsystems technology and precision components

Fraunhofer Institute for Mechanics of Materials IWM
Wöhlerstrasse 11
79108 Freiburg, Germany
Phone +49 761 5142-0

The Fraunhofer IWM is the point of contact for industry and public contracting bodies concerning component and systems reliability, safety, durability and functionality. The Fraunhofer IWM's »mechanics of materials« services focus upon identifying weaknesses and defects in materials and components, determining their causes and building upon this to realize solutions – including material development, manufacturing processes and testing procedures – that lead to the efficient and reliable use of components.

Contact

Martin Krappitz
Phone +49 761 5142-108
martin.krappitz@iwm.fraunhofer.de

Tobias Rist
Phone +49 761 5142-430
tobias.rist@iwm.fraunhofer.de

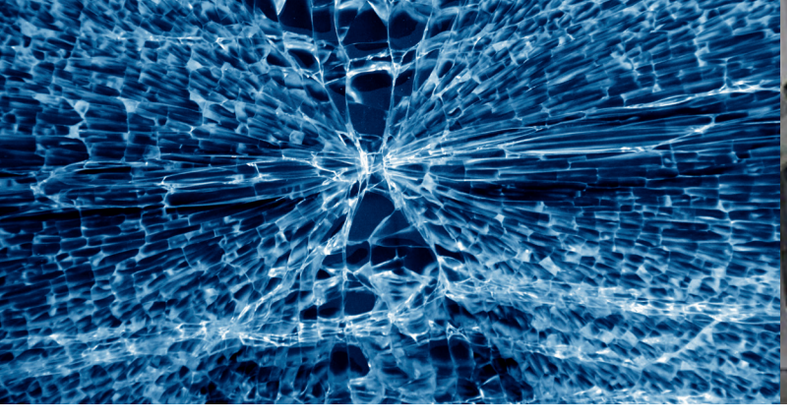
WWW.IWM.FRAUNHOFER.DE

f_1607_143e

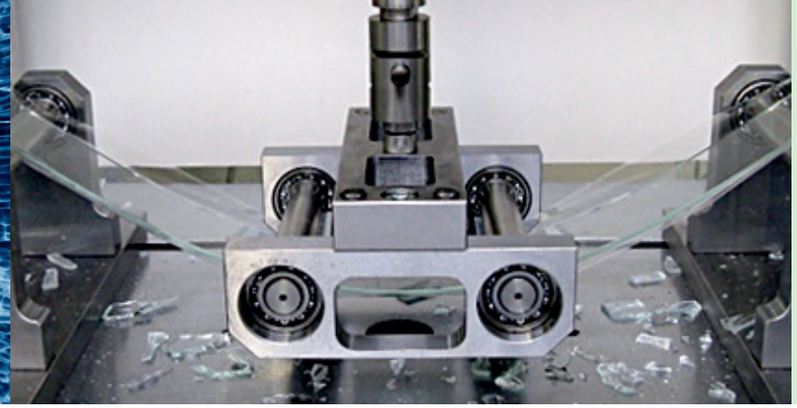
Fraunhofer
IWM

FRAUNHOFER INSTITUTE FOR MECHANICS OF MATERIALS IWM

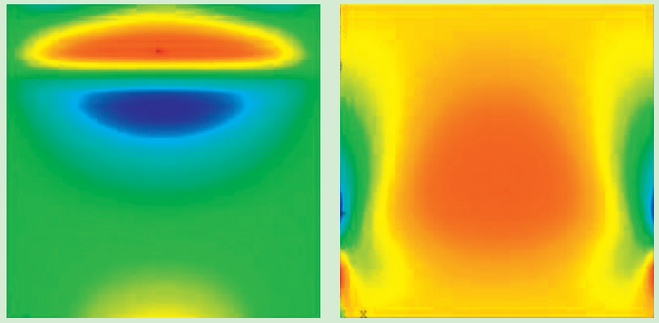
FAILURE ANALYSIS IN BRITTLE MATERIALS



Damage to single-pane safety glass (ESG).



Stress test on glass with thermally cut edges.



Numerically calculated distribution of stresses in a silicon wafer.

Damage analysis

On the basis of many years of experience with failure events, Fraunhofer IWM has developed concepts for characterizing and analyzing failure in brittle materials such as glass and silicon. These concepts have been used many times on glass components for automotive applications, for architecture and in solar power modules and solar cells for determining the causes of failure.

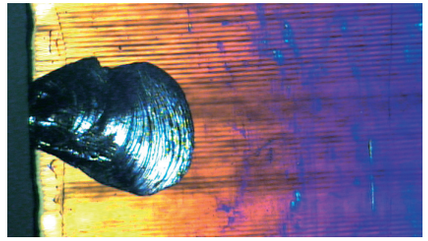
Tests are performed on single panes, domestic glass, solar wafers and solar cells and on complete units such as windows, complex glazing systems and solar modules that have been damaged or broken either during manufacture or later during use. These tests provide conclusions as to the mechanism of the breakage, the causes of failure, initial damage and how the failure developed.

Identifying the causes of failure gives customers valuable insight into the development of manufacturing processes with low failure rates and into improving the mechanical properties of products during their end use.

Strength testing

Strength tests are performed after individual production steps in which the introduction of crack-like failures into the brittle material and the spread of pre-failure damage by each production step are quantified. Systematic investigations are performed to identify critical production steps.

Knowledge about the critical production steps is important so that appropriate modifications to the production method can be made to improve the products and their reliability and durability.



Chipping of a wafer edge due to a handling error (waver impacted against the stopper pin).

Process analysis

In process analyses the effects of individual process steps on the production process are examined with regard to mechanical properties and strength. Depending on the specific application, such analyses contain experimental measurements e.g. of temperatures and tensions, plus investigations and tests at the production site and numerical simulations to display the stresses arising and to enable internal stresses and damage to be recorded. They provide our clients with sound data for the evaluation of production steps and for process optimization.

Special test methods are also developed to allow early detection of pre-damaged parts and to allow items to be separated out during intermediate steps of the production process. The necessary qualitative criteria for classifying parts as ‘good’ or ‘bad’ are obtained from fracture mechanics analyses.