

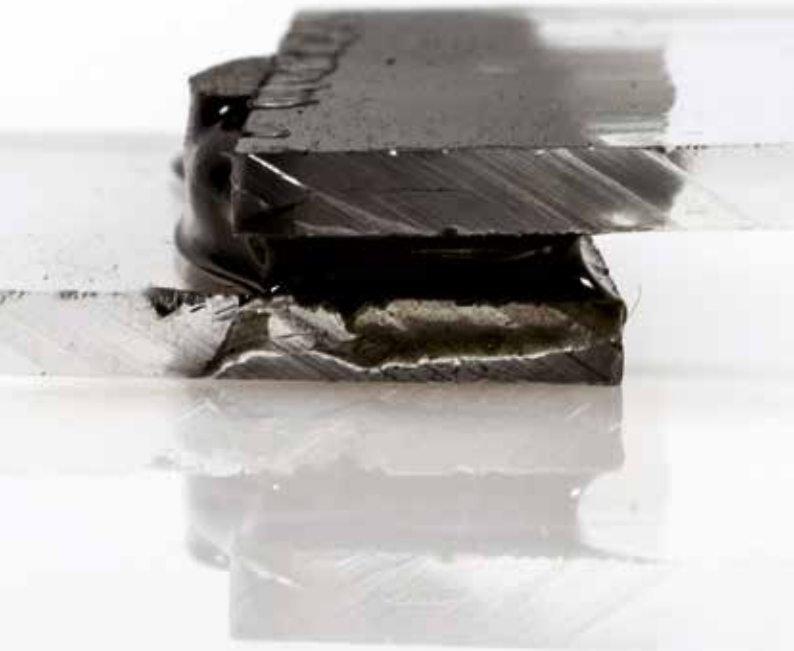


Fraunhofer

ICT

FRAUNHOFER INSTITUTE FOR
CHEMICAL TECHNOLOGY ICT

**FAST HARDENING AND
DEBONDING OF ADHESIVES
BY MICROWAVES**



FAST HARDENING AND DEBONDING OF ADHESIVES BY MICROWAVES

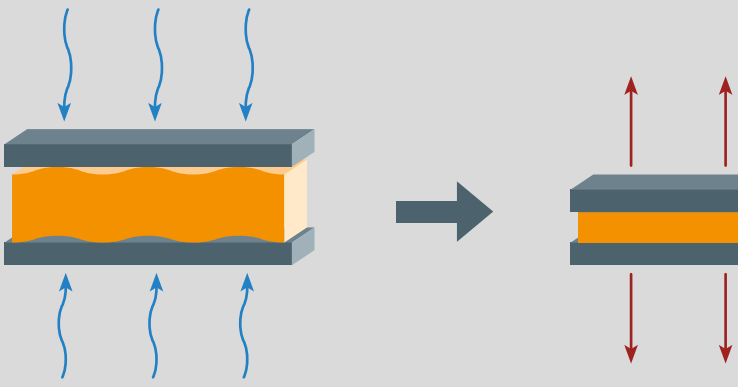
ADHESIVES AS AN ALTERNATIVE JOINING METHOD

As an alternative to mechanical joining methods such as welding and riveting, adhesives have gained importance in recent years and are being integrated into increasing numbers of production processes. Modern processes are no longer conceivable without them.

Bonding technology is especially important in the automotive, rail vehicle and aircraft construction sectors and in the production of "white goods", because these manufacturing areas use a variety of materials and the joining technologies therefore play a key role. Adhesives offer constructive benefits, especially in the area of lightweight construction.

High-strength adhesives are also used for multi-material design in the field of fiber-reinforced plastic materials (FRP), in which the reinforcing fibers are often embedded in thermo-setting matrices.

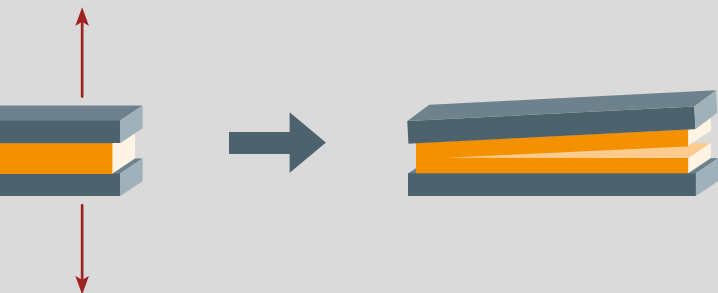
However, a problem is posed by the rapid hardening and debonding of these compounds.



ADHESIVE CURING

Microwaves for adhesive curing are especially well-suited where a mixture of metallic and non-metallic substrates is used (hybrid components), for example when ceramic boards are bonded to heatsinks, or where plastic components are joined to a metal frame. These scenarios frequently apply in the automotive industry and the manufacture of “white goods”. The microwave technology offers the possibility to heat and activate an adhesive using high-frequency radiation. As a result, depending on the adhesive system, the curing time can be reduced to a few seconds.

With conventional bonding techniques the cycle time is often reduced because the long curing times mean that a mechanical component fixation is necessary. This fixation reduces the benefits of the bonding process, such as compensation for tolerances, design and installation freedom. The local heating of the adhesive by microwaves, which occurs in a matter of seconds, means that fewer local points are needed to achieve a sufficient handling strength. The adhesive may then cure completely at room temperature, depending on the application, unless a geometrically-consistent, rapid radiation curing is needed.



Using customized microwave antennas adapted to the application and geometry, microwave heating for the bonding process can be reproducibly and safely integrated into the production process, for example on a handling robot with high operating speeds. Microwaves are especially suitable for heating an adhesive or sealant between two polymeric substrates. Here the radiation is not absorbed by the joining partners but only by the adhesive, minimizing thermal component stress.

To modify commercially-available and established adhesive systems the microwave-suitability can be determined by measuring the absorption properties, and the adhesive system can be adapted by adding a largely neutral radiation absorber which does not alter the desired adhesive properties.

DEBONDING OF ADHESIVES

At present no methods are available that allow rapid and force-free debonding to make corrections in the production process, repair damaged components or recycle the materials at the end of the product lifecycle. The introduction of microwave-active and exothermically-reacting substances in an adhesive matrix allows a systematic loosening of bonded joints “at the touch of a button”. When these substances absorb microwave radiation, an exothermic reaction is initiated which damages the polymer matrix and counteracts the adhesive effect.



The advantages of microwave-debonding are:

- Possibility of debonding poorly accessible bonds
- Low impact on joining part due to detackifying
- Possibility of reassembly
- Low residual force of the debonding reaction
- Low hazard potential

OUR OFFER

Development and adaptation of adhesive systems and applications for specific tasks according to customer requirements in the areas of:

- Study of the suitability of the adhesive for accelerated curing using microwaves
- Modification of the adhesive in order to increase the microwave absorption
- Development of suitable microwave antennas for application
- Process development
- Development of releasable adhesives according to customers' requirements
- Adaptation of the debonding reaction
- Analysis and testing of adhesives

CONTACT

Fraunhofer Institute for Chemical Technology ICT

Joseph-von-Fraunhofer-Strasse 7
76327 Pfinztal (Berghausen)
Germany

Director:
Prof. Dr.-Ing. Peter Elsner

Contact

Stefan Sims
Phone +49 7 21 46 40-554
stefan.sims@ict.fraunhofer.de

www.ict.fraunhofer.de