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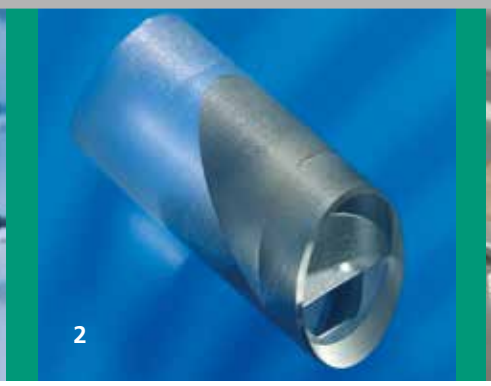
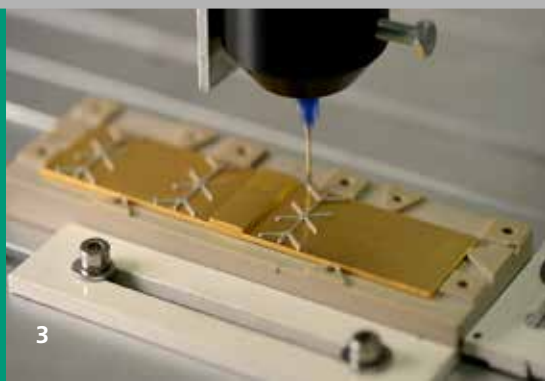
FRAUNHOFER INSTITUTE FOR MANUFACTURING TECHNOLOGY AND ADVANCED MATERIALS IFAM





1 *Mechanical testing of a component bonded with an electrically conductive adhesive.*
2 *Bonded optics in an endoscope.*
3 *Automated application of an electrically conductive adhesive.*

ADHESIVE BONDING IN MICRO-PRODUCTION

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Status quo

In the areas of microsystem technology, precision engineering, medical technology, microelectronics, optics, and optoelectronics, the use of adhesives is opening up new opportunities for companies to produce very small components that perform diverse functions in a small space. Micro-bonding also allows complex structures with customized configurations to be assembled.

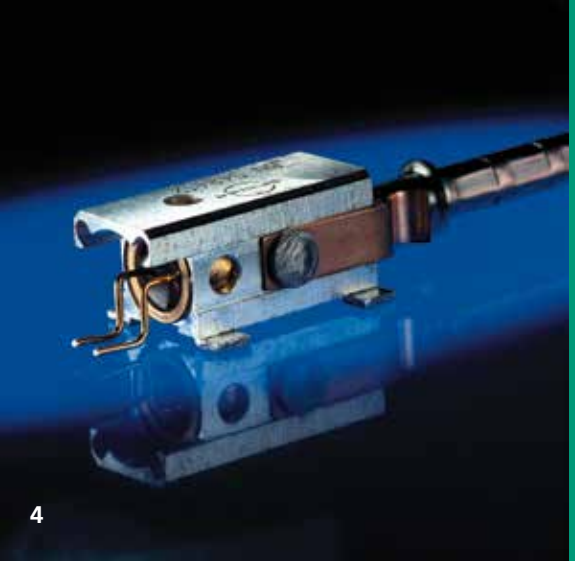
Micro-production

Adhesive bonding on a micro-scale brings a host of new challenges, because there are subtle differences in the properties of adhesives when used on a micro-scale compared to the macro-scale. The Fraunhofer IFAM specialists in adhesive bonding technology have the know-how and expertise to take on these challenges. Working together with customers, they develop tailored micro-bonding solutions.

The success of adhesive bonding on a micro-scale requires perfect adaptation of the adhesive to the production process. For example, the bonded joints must have low stress because internal stress in joints is one of the main causes of faults and failure.

Adhesive bonding in optics

In order to use light as an information carrier, it is necessary to join high-precision, miniature optical components to each other. The use of adhesives here allows low stress, dimensionally stable joints to be formed. If necessary, low-loss optically transparent joints can be manufactured.



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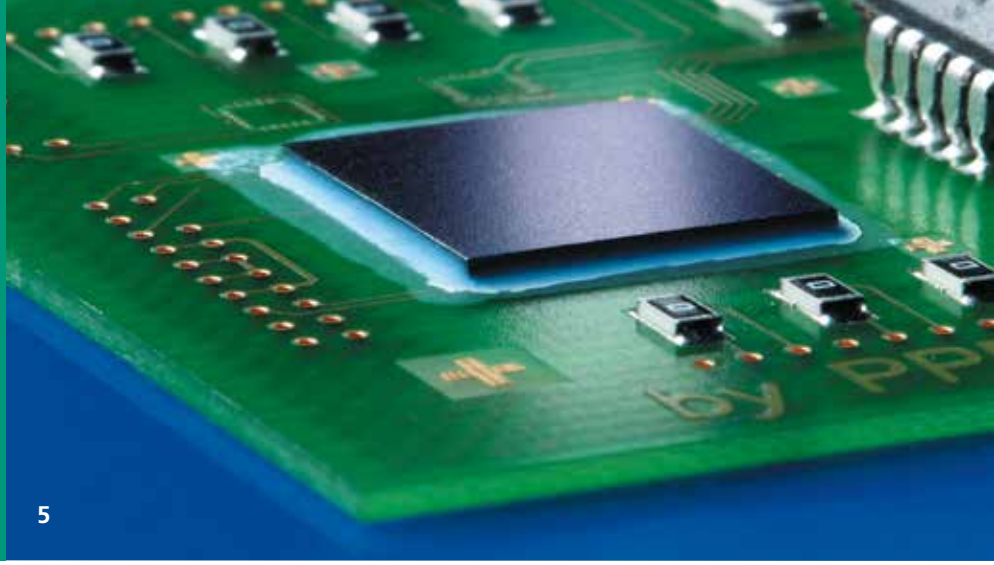

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Adhesive bonding in medical technology

The area of medical technology covers a wide range of devices and instruments for diagnosis and therapy and also prosthetics and implants. For prosthetics and implants the biocompatibility of an adhesive is an important factor, whilst for instrumentation there is ever growing cost pressure and the simultaneous demand for high quality products.

The assembly of the endoscope shown in Figure 2 involved the use of highly transparent adhesives with customized refractive indices. The lens diameter is ca. 2.7 mm. The adhesively bonded endoscope objective is able to withstand the temperature variations of the sterilization process that is essential after each use of a medical instrument. The optical quality of the endoscope is not affected by this.

Adhesive bonding in microelectronics

The use of electrically conductive adhesives allows products to be manufactured that cannot be produced with conventional joining methods. For example, the somewhat elastic but nevertheless very strong adhesive bonding of chips and other electronic components to flexible printed circuit boards form the basis for innovative applications in many areas.

The region between the board and components is filled with a low-viscosity underfill in order to absorb mechanical loads and dissipate process heat.

Range of services offered by the Fraunhofer IFAM

- **Adhesives**
  - Drawing up of adhesive specifications for use on the micro-scale
  - Identification and selection of commercially available adhesives that meet the specifications
  - Adhesive modification and development to meet customer-specific requirements
  - Characterization of adhesives in their non-cured and cured states
- **Design**
  - Analysis of potential loads and internal stresses using the finite element method (FEM)
  - Optimization of bonded joints to minimize joint stress
- **Pre-treatment**
  - Cleaning and pre-treatment procedures in order to optimize the adhesion
- **Production**
  - Drawing up of production concepts
    - ➔ Selection of methods and equipment for the reproducible application of the required quantity of adhesive (e. g. dispensers, jets, screen/stencil/stamp printing)
    - ➔ Adjustment of the adhesive film thickness by controlling the force or displacement
    - ➔ Positioning of the substrates
    - ➔ Determination of curing parameters, for example for rapid bonding processes or low-stress bonded joints
    - ➔ In-line monitoring of the adhesive application and joining process
  - Process analysis
    - ➔ Reproducibility of bonded joints and avoidance of defective components
    - ➔ Optimization of the process management
    - ➔ Traceability of the process
- **End properties**
  - Qualification of bonded joints using generally recognized or specially customized test methods
- **Failure/damage analysis**

4 *Tolerance-compensating bonded joint for a VCSEL diode and SMD housing.*

5 *Underfill of an electronic assembly.*