Fraunhofer IFAM

Adhesives as composite materials and composites

Customized solutions

The development and evaluation of customer-specific materials and adhesives is a central focus of our institute's work. Adhesives as composite materials play a major role in this. The outstanding properties of these adhesives are more than the sum of the individual components. This is the great potential, because there is a wide range of raw materials which – cleverly formulated – can optimize the final properties of an adhesive. Examples for certain properties are electrical or thermal conductivity, toughness, flame retardance and recyclability, which is becoming increasingly important.

Composite materials enable the functionalization of adhesives and adhesives

A composite material is a material made of two or more joined materials. The composite material has different properties than its individual components. The fire behavior of a material can be improved by the addition of flame retardants or by adding stabilizers to resist high temperature. The chemistry of the various components plays a decisive role. Only when these are combined with the parts to be joined, improved manufacturing processes or component properties are achieved. For example, it is possible to achieve a simultaneous strength and elongation at break or a low curing shrinkage and coefficient of thermal expansion (CTE).

Significant process costs can also be saved. By influencing the rheology and curing speed of composites, for example, a furnace process can be reduced from 150 °C to 100 °C. In addition to cost savings, this also leads to a lower CO_2 footprint.

Adhesives with thermal conductivity

The production of adhesives with thermal conductivity is one of our core competencies. Adapting the thermally conductive properties to those required by the end user, or achieving them additively without impairing other important properties, is a major task. For example, the addition of highly thermally conductive fillers is often accompanied by an impairment of the rheological behavior. However, by further additive addition and the right mixing technique, many systems can be further adapted. It is precisely for this purpose that we have drawn on our many years of experience and our extensive analytical methods to develop customized solutions.

Reduction of the CO_2 footprint through recycling and the use of renewable raw materials

The issue of sustainability is becoming increasingly important across all industries. Among other things, the recycling of materials plays a major role here. Up to now, this has been a significant challenge in the case of composites due to the tight bonding of different materials. Fraunhofer IFAM therefore deals with both the use of renewable raw materials into biocomposites from environmentally friendly and completely degradable raw materials as well as with questions concerning the debonding of adhesive bonds. This can be applied synergistically but does not have to be. Corresponding products can be used, for example, in the packaging industry or the agricultural industry, but they are also in high demand in the construction and automotive industry.

Many advantages using nanocomposites

Adhesives with nanocomposites consist of a polymer matrix and nanoparticles, which are used as fillers in the matrix. Nanoparticles offer many advantages over other fillers: they distribute evenly in the matrix and thus prevent cracking, which increases the service life of components. In addition, nanoparticles can be used to produce new properties without having to accept negative effects such as lower strength or toughness. In addition, their use is often a cost-effective alternative. One example of this is electrically conductive adhesives. Silver is often used here as a filler. However, silver is expensive and is also difficult to process. The use of nanocomposites can reduce these problems.

Your contact for the expertise composites

Dr. Thomas Kowalik is deputy head of the "Adhesives and Polymer Chemistry" department. For more than 20 years, he has been involved in the development of composite-based adhesives to give them special material properties. In this context, he accompanied the development of microelectronics through work on special electrically conductive adhesives, as well as optimized UV initiators. The use of nanocomposites to increase the toughness of matrix resin systems in lightweight fiber composite construction, as well as application-adapted thermally conductive adhesives and thermally conductive pastes are the subject of research and development within the department. For almost as long, the topics of debonding on demand and flame retardancy. In recent years, the focus has been strongly towards adhesives based on renewable raw materials and the recyclability of bonded joints.

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Adhesive Bonding Technology and Surfaces

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