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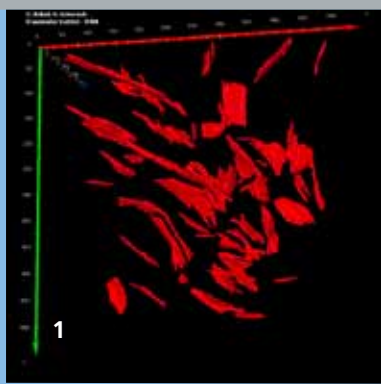
FRAUNHOFER-INSTITUT FÜR FERTIGUNGSTECHNIK UND ANGEWANDTE MATERIALFORSCHUNG IFAM



1 *3D TEM image of a layered silicate perfectly distributed in an epoxy resin.*

NANOCOMPOSITES

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In recent years, the main advancement in polymer chemistry has not been the development of new monomers but has been, for example, the incorporation of additives and fillers into polymers, in particular nano-fillers. This results in nanocomposites or organic-inorganic hybrid polymers.

A special feature of hybrid polymers is that the inorganic additives are distributed in the polymer matrix down to the nanoscale level. Ideally, the two phases are chemically bonded with each other. Compared to conventional filler materials, the amounts added are usually considerably low. We are hence dealing with additives here rather than fillers.

Effects that can be achieved

By incorporating nano-fillers it is possible, for example, to simultaneously increase the toughness and strength of a polymer and improve the fire resistance properties.

By reducing the permeation of moisture and other media, the barrier properties of, for example, bonded joints and hence their resistance to warm, humid conditions are improved.

Development of new nano-fillers

Suitable nano-fillers for modification of most polymers are not commercially available. In particular this concerns the surface composition of particles as a prerequisite for distribution of the particles at the nano-level.

If there is poor interaction between the polymer and the surfaces of particles, the expected effects by the nanoparticles are usually not measured. However, the surface chemistry of the particles is not the unique important factor. The processing technologies employed to modify the particles and to incorporate them into the polymer are also decisive.

For example, when sufficiently modified nanoparticles are incorporated into a formulation at just five percent level and using the exactly right processing technology, then lap shear strengths of adhesive bonds can be more than doubled with simultaneous increase in the peel strength.

Portfolio of the Fraunhofer IFAM

- Development of novel nano-fillers and modification of existing nanofillers
- Surface chemistry of the particles: interface design and processing technology
- Incorporation of the fillers into thermosetting and thermoplastic polymers, e. g. by extrusion, dispersion or kneading
- Modification of combustion and mechanical properties of adhesives, paints/lacquers, and other polymers
- Characterization of the fillers by light scattering, zeta-potential measurements and application of high-resolution microscopic techniques