Presseinformation

Designer materials

It looks and feels like orange plastic. Not very exciting, one might think. But the new benzoxazine polymer – basis of Henkel's Epsilon technology – has hidden talents. Formula One drivers and aircraft passengers will love it.

Carbon fiber reinforced plastics are being used more and more. They not only make racing cars lighter and faster, but aircrafts as well. And planes that weigh less also consume substantially less fuel. A technology with a big future that benefits both people and the environment. More than one-fifth of the structures making up the high-capacity Airbus A380 consist of lightweight synthetic composite materials. In the future Dreamliner from Boeing and the A350 XWB from Airbus even the wings and fuselage are to be manufactured using composites.

Composites are based on long carbon or ceramic fibers. Although these fibers can withstand very high loads, they are not dimensionally stable. The fibers are therefore embedded in matrix resins such as Henkel's new Epsilon technology, the benzoxazine polymer. These resins ideally combine the best properties of glass (very hard) and rubber (elastic). "Benzoxazine polymers are normally brittle. Our goal was to make them tough, elastic, and ultimately also crash-resistant, without compromising on hardness or strength," says Dr. Rainer Schönfeld from Henkel Corporate Research. The key to achieving this was morphology control. This means modifying the inner structure of a material so that it will combine normally conflicting properties. The process is a little like preparing a salad dressing: oil and vinegar normally don't mix, but adding mustard or an egg yolk can help to bind them into a stable emulsion.

A team of 16 scientists and product developers from Henkel sites in Germany, the USA and Japan systematically investigated the relationships between the chemical composition of the matrix resins, their internal morphology, and the resulting mechanical properties. By modifying the morphology of benzoxazine polymers it was possible to increase their toughness by a factor of four while achieving exceptionally high flexibility and strength. Working on the molecular level, the researchers anchored tiny particles of rubber in the matrix. These rubber particles act like miniature shock absorbers.

With this project, the Henkel researchers were acting with an eye to the future. As Schönfeld says, "We wanted to explore the basic structure property relationships in polymers of this kind. We now have a toolbox that will allow us to design specific properties into materials by modifying their molecular structure and morphology."

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