TAILORED REACTIVE JOINING OF PLASTICS

The demand for innovative lightweight design is driving the development of novel materials and material combinations. There lies great potential in the use of plastics, in particular. This also increases the challenges faced by techniques used to join together plastics or combine them with different materials.

Conventional joining processes, such as welding, usually introduce considerable heat into the component, warming up not only the joint zone. As a result, the material's microstructure changes, which in turn leads to undesirable property degradation. Other processes, such as adhesive bonding, tend to age and demand pre- and post-treatments that can result in costly and time-consuming processes. Joining with reactive multilayer systems (RMS) offers an option to overcome conventional joining technologies' limitations. RMS are customized heat sources consisting of two chemical elements positioned in alternating layers. Introducing activation energy into this system causes a self-propagating exothermal reaction front that spontaneously sets free heat. This is used to melt the surface zone of the thermoplastics. Adhesive bonding is achieved by additional joining pressure. Fraunhofer IWS scientists designed the RMS technology for strong, damage-free plastic bonding without any pre- and post-treatment. They not only selected the suitable RMS, but also modified the joining pressure, and considered the joining parts' surface characteristics. While the appropriate RMS type primarily prevents damage to the thermoplastic matrix, joining pressure and surface roughness are decisive for ensuring high strength. Joining strength values ranging from 20 to 30 megapascals were achieved for many thermoplastics. RMS joints with thermoplastics offer long-term stability if the parent material itself is durable. Thus, for instance, the thermoplastics polyphenylene sulfide, polycarbonate, and polyamide 6 demonstrated excellent stability in various ageing tests. In addition to pure plastics joints, mixed-material joints consisting of plastics and metals are also interesting. The RMS technology also proved capable of fabricating strong hybrid material joints.

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