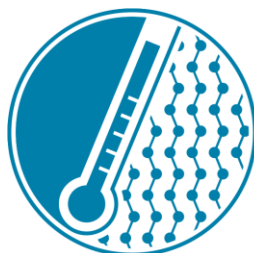


PolyTherm
Polymers for Thermally
Demanding Applications

Programme: COMET – Competence
Centers for Excellent Technologies

Programme line: COMET-Project

Type of project: Expanding
Polymers: Assembly Components
with Tailor-Made Geometric
Alignment, 04/2017-07/2021,
multi-firm project



PolyTherm
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POLYMERS WITH UNEXPECTEDLY HIGH VOLUMETRICAL EXPANSION DURING CURING

MANY RESINS, SUCH AS ADHESIVES, SHOW VOLUMETRIC SHRINKAGE DURING THE CURING REACTION, UNLIKE SO-CALLED FOAMS. IF THIS SHRINKAGE IS EXCESSIVE, THE CURED RESIN MAY SHOW CRACKING AND EVEN DELAMINATION. RESEARCHERS AT THE POLYMER COMPETENCE CENTER LEOBEN HAVE DEVELOPED A NEW RESIN FORMULATION THAT SHOWS AN UNPRESENTED VOLUMETRIC EXPANSION DURING CURING WITHOUT THE NEED TO FOAM THE RESIN.

Volumetric shrinkage during the curing reaction of resins and adhesives

During the curing reaction of resins, monomers are linked to one another via chemical bonds, which causes the distance to shorten, such that volumetric shrinkage occurs.

A strategy to counteract this effect is the use of ring-shaped monomers: The opening of the ring structures during the curing reaction causes volumetric expansion, such that the overall shrinkage (of the resin formulation) is reduced or such that even volumetric expansion occurs.

SUCCESS STORY

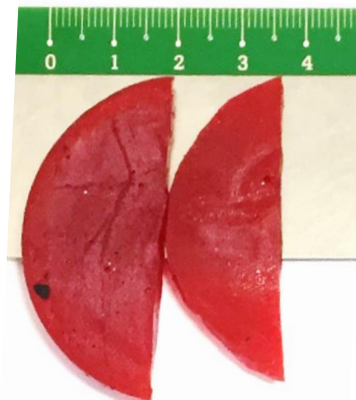
Resins based on benzoxazines and cyclic carbonates

To date, resin formulations containing different types of ring-opening monomers have been investigated seldomly only. Both, benzoxazines and cyclic carbonates, are used in a new type of resin mixture developed at the Polymer Competence Center Leoben. Such resins exhibit unexpectedly high expansions, greater than 20 percent by volume. The high expansion rates of the resins based on benzoxazines and cyclic carbonates originates from the ring-opening of the monomers during the curing reaction, so that, unlike in the production of foams, molded articles are formed without an enclosed bubble structure.

Impacts and effects

Due to the generic design of the new resins based on benzoxazines and cyclic carbonates, these resins can be formulated either as pourable or spreadable liquid formulations or as pre-crosslinked solid moldings. Such pre-crosslinked solids can be fitted into molds to be filled and then expanded by heating, whereby they adapt to the surrounding geometry.

Because the resins expand without forming a bubble structure, they are electrically insulating, unlike conventional foams. They can therefore be used in numerous fields of application, for example in microelectronics and high-voltage technology as well as in all process routines in which shape adjustment is of great relevance.



Change in size of a pre-crosslinked solid formulation based on benzoxazines and cyclic carbonates (right) to an expanded molded body (left). © PCCL

Projektkoordination (Story)

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Project partner

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- TU Graz, AT
- Siemens AG Österreich, AT
- MU Leoben, AT
- AVL List GmbH, AT

This success story was provided by the Polymer Competence Center Leoben GmbH for the purpose of being published on the FFG website. PolyTherm is a COMET Project within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMDW, SFG. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet