N-heterocyclic Carbenes as Hardener for Anhydride-Epoxide-Vitrimers

Hagen Altmann*[1], Dominik Weidich[1], Iris Elser[1], Michael Buchmeiser[2,1], and Malte Kastner[3]

[1]German Institutes of Textile and Fiber Research Denkendorf – Germany
[2]Institute of Polymer Chemistry, University of Stuttgart – Germany
[3]Department of Conversion Technologies of Biobased Resources, University of Hohenheim – Germany

Abstract

The concept of vitrimers and the concept of latency provided by coordinated N-heterocyclic carbenes (NHCs) were both applied to anhydride-hardened epoxide resins separately. In this ongoing research both concepts were merged. Vitrimers are defined as covalent networks with associative exchangeable bonds. The bond exchange on the molecular level, under preservation of the absolute number of bonds, allows to change the macroscopic topology. NHCs have a divalent carbon atom with a fully occupied sp2-orbital and an empty p-orbital. This carbon atom is bond to two nitrogen atoms that stabilize the carbene within the ring. To gain a latent NHC initiator the nucleophilic and basic sp2-orbital is coordinated to small, polar molecules like CO2 or metal salts. Different anhydrides and epoxides as well as exchange catalysts have been researched towards their mixability with the polar blocked NHCs. Homogeneous mixtures were further applied in curing experiments via differential scanning calorimetry measurements and by observing the rheological behavior during a temperature scan. Samples, made from the identified resins, were prepared to investigate the thermal and mechanical behavior and the fundamental feasibility of post curing topology change. Upcoming the resins will be applied in vacuum driven processes and pultrusion to produce fiber reinforced composites.

Keywords: vitrimers, N, heterocyclic carbenes, epoxide resins, latency

*Speaker