SYNTHESIS AND INVESTIGATION OF VANILLIN-BASED VITRIMERS

Brigita Kazlauskaitė[1], Sigita Grauželienė[1], Jolita Ostrauskaitė[1]

[1]Department of Polymer Chemistry and Technology, Kaunas University of Technology, Lithuania
b.kazlauskaite@ktu.edu

Vitrimers are a class of materials that exhibit a dynamic covalent behavior similar to that of traditional polymers, but with the ability to undergo reversible chemical transformations without losing their material properties [1]. This dynamic nature allows to be reshaped, reprocessed, and recycled multiple times without losing their mechanical properties [2]. The ability to undergo reversible reactions makes vitrimers attractive for applications in self-healing, recyclable and shape-memory polymers.

The aim of this research was to synthesize sustainable materials using functionalized vanillin due to its antibacterial and antifungal properties which are relevant nowadays. Functionalized vanillin can be a good alternative to the most widely used cross-linker with the bisphenol A fragment, as it has a vanillin-based backbone with high rigidity and thermal stability. Studies have suggested that bisphenol A can mimic the action of the hormone estrogen in the body. There is ongoing research and debate regarding the potential health effects of bisphenol A exposure, with concerns raised about its possible links to reproductive, developmental, and endocrine-related issues [3]. Consequently, functionalized vanillin (Fig. 1) together with other monomers in different ratios was chosen for the preparation of UV-curable resins. Functionalized bisphenol A was chosen to compare the properties of the resulting polymers. The synthesized vitrimers showed reprocessability, shape memory, and self-healing properties due to a sufficient amount of hydroxyl and ester groups that are beneficial for transesterification reactions. The properties of vanillin-based vitrimers were similar to those of bisphenol A-based vitrimers.

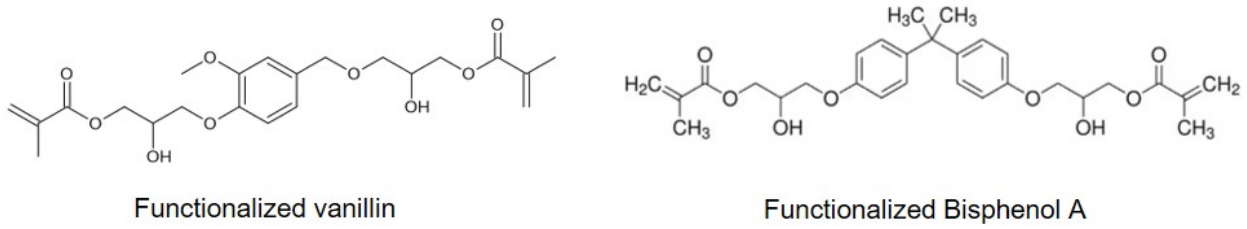

Fig. 1. Chemical structures of functionalized vanillin and Bisphenol A.

Acknowledgement. This research was funded by the Research Council of Lithuania (project No. S-MIP-23-52).

[1] W. Post, A. Susa, R. Blaauw et al., A Review on the Potential and Limitations of Recyclable Thermosets for Structural Applications, Polymer Reviews 60, 359-388 (2020).

[2] B. Zhang, K. Kowsari, A. Serjouei et al., Reprocessable thermosets for sustainable three-dimensional printing, Nature Communications 9, 1831, (2018).

[3] H. E. Costa, E. Cairrao, E. Effect of bisphenol A on the neurological system: A review update. Archives of Toxicology., 98, 1-73 (2024).