Sustainable synthesis of polymer networks

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The awareness of environmental deterioration and our dependency on depleting fossil feedstocks forces research to find innovative solutions in order to design a more sustainable future.[1] Improving the sustainability of polymer networks is a crucial challenge in polymer science, due to their important role industry. Their traditional syntheses conflict with several principles of *Green Chemistry* as the employed monomers are petroleum-based, their production involves the use of toxic reagents and their permanently cross-linked structures impede their chemical recycling and reshaping. These aspects will be addressed in the presentation using lignin-derived phenolic compounds and terpene-based derivatives as renewable feedstocks. The use of safer synthetic procedures will be illustrated by (i) the development of an enzymatic dimerization process for the sustainable production of biobased biphenyl compounds[2] and (ii) the replacement of classic toxic allylation procedures by more sustainable catalytic alternatives using palladium nanoparticles stabilized by poly(vinylpyrrolidone) as highly efficient catalysts for the Tsuji-Trost reaction[3]. An approach to enhance the recyclability of thermoset materials by the design of biobased cleavable monomers will also be exposed. In this work, vanillyl alcohol was modified by an allylation and, in some cases, epoxidation procedure. In order to introduce recyclability into the final polymer networks, the modified vanillin building blocks were subsequently coupled to form dimeric structures bearing cleavable linker groups. The dienes were later polymerized by thiol-ene reaction with a myrcene-based trithiol to prepare transparent cross-linked films. The diglycidyl ethers were investigated as substitutes of bisphenol A for the preparation of epoxy resins by combination with limonene-based monomers. Finally, different degradation conditions were explored to establish a protocol for the controlled degradation of the cross-linked polymers. In a first step, the cleavable monomers were used as model systems to identify suitable degradation conditions. Subsequently, the most promising conditions were transferred to the polymer films to prove the degradability of the polymer network.

Références :

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