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Furan-melamine-formaldehyde polymers—towards smart materials future applications

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Functionalized polymers or polymer particles are highly requested in material research, as they can be used in smart materials, functional coatings or in biochemistry. Particles are used in different fields of research, for example as catalyst support, drug carrier, adsorption material, or template. Melamine is a nontoxic, white, odorless hetero-aromatic chemical, which, in combination with formaldehyde is used as a raw material for various industrial applications. Their exceptional properties, such as high density (1.51g cm^{-1}), a cationic surface, outstanding (chemical) robustness and wear resistance, make melamine formaldehyde (MF) particles an attractive material in various fields of research. However, the functionalization of MF particles is hardly found in the literature. Furanic compounds are renewable resources which can be directly obtained from hemicelluloses that are abundant in sugarcane bagasse, oat hulls, corn husks, rice and wheat straw. Acid-catalyzed hydrolysis of pentosans followed by dehydration and cyclization of the ensuing pentoses leads to the formation of furfural, which is the most important first-generation furan derivative today. The inspiration for this work was to combine the above named properties of MF cores with the chemical advantages of furanic units, which might find some applications for reversible reactions, as used in drug delivery systems or self-healing applications. In the literature, several examples can be found, where furan moieties are already introduced in different polymeric matrices like methacrylates, epoxy amine matrices, thermosetting polyketones or polyurethanes.

Recent Publications:

1. T-W Chuo and Y-L Liu (2017) Furan-functionalized aniline trimer based self-healing polymers exhibiting high efficiency of anticorrosion. Polymer (Guildf) 125:227–233.
2. N Esmaeili, M J Zohuriaan-Mehr, S Mohajeri, K Kabiri, and H Bouhendi (2017) Hydroxymethyl furfural-modified urea–formaldehyde resin: synthesis and properties. Eur. J. Wood Wood Prod. 75(1):71–80.
3. L Liu, P Yang, J Li, Z Zhang, X Yu, et al. (2017) Temperature-controlled cross-linking of silver nanoparticles with Diels-Alder reaction and its application on antibacterial property. Appl. Surf. Sci. 403:435–440.
4. K Urdl, A Kandelbauer, W Kern, U Müller, M Thebault, et al. (2016) Self-healing of densely crosslinked thermoset polymers—a critical review. Prog. Org. Coatings 104:232–249.
5. S Chen and L Zhang (2005) Synthesis of melamine-glucose resin adhesive. Sci. China Ser. B Chem. 48(S1):29–32.

Biography

Katharina Urdl completed her Chemistry studies at the Chemistry and Technology of Materials Department at the Technical University of Graz in 2016. She is currently employed at the Wood Carinthian Competence Center in St. Veit/Glan in Austria. In 2016, she started with the Doctoral Program in Polymer Engineering and Science at the Montanuniversität Leoben. She is currently working in a project on modification of melamine-formaldehyde resins used in decorative laminates industry.

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