Novel Mussel-Inspired Polyhydroxyurethane Adhesives for Aerospace and Automotive Applications

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In the last five years, isocyanates-free poly (hydroxyurethane)s (PHUs), synthesized by step-growth polymerization between bis-cyclic carbonates and di- or poly-amines, have emerged as a novel class of polyurethanes (PUs). These PHUs find promising applications in flooring, paints, as thermoset materials or (thermal insulation) foams. PHUs can be also exploited advantageously for designing the next generation of high-performance polyurethane adhesives. Thanks to the presence of pendant hydroxyl groups favoring the polymer/substrate interactions, the adhesion performances of PHUs may equal or even surpass the ones of conventional PUs. In this contribution, we focused on the design of novel reinforced bio- and CO_2-based PHU thermosets adhesives with high shear adhesion strength for metal substrates (aluminum and stainless steel). The research included: The synthesis of a library of bi- or multifunctional 5-membered cyclic carbonates by coupling CO_2 with (bio- based) epoxidized precursors using a novel home-made binary organocatalyst highly performant under very mild experimental conditions. The development of solvent-free reinforced PHU thermoset adhesives from various cyclic carbonate/amine/functional fillers formulations. For all formulations, curing kinetics was monitored by rheology to determine the gelation time and the thermo- mechanical and physico-chemical properties of PHUs were evaluated on free-standing films. The evaluation of the adhesives performances for metal sticking: The adhesion of (reinforced) PHUs onto Al-2024-T3 or stainless-steel substrates was evaluated by standard cross-cut adhesion (5B) and MEK double rubber (>300) tests and shear adhesion strength (> 28 MPa).

Biography: Dr. Satyannarayana PANCHIREDDY received his PhD degree in Polymer science from University of Liege (CERM, Belgium) with Prof. Christine Jerome, and Prof. Christophe Detrembleur in 2018. His research was focused on the development of CO2–sourced sustainable polyurethanes for aerospace and automotive applications. Later he joined at UCLouvain as a postdoctoral researcher in 2019. His research is mainly focused on solid polyelectrolytes for lithium-ion batteries.

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