# Increasing bio-based and circular content of a thermosetting polyurethane for encapsulation of optoelectronic devices: a multivariate investigation

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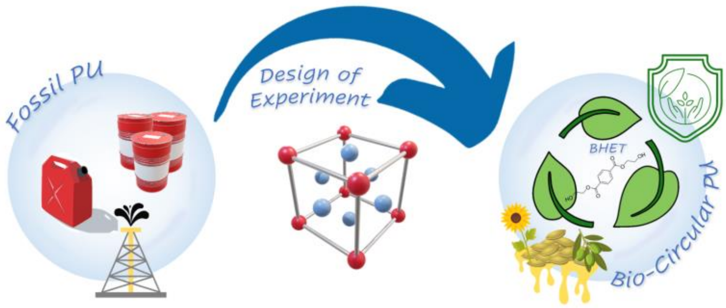


In recent years, the use of polyurethanes (PUs) has enormously increased in the industrial context for their versatile synthesis and tunable physicochemical properties. Nowadays PU-based materials are massively used in many fields, from building construction to automotive, to biomedical application [1]. However, the wide use of fossil-based precursors leads to negative environmental impacts and poor sustainability. Thus, it is essential to implement alternative reagents, aiming to improve the sustainability of polyurethanes reducing resource consumption and carbon footprint [2,3]. In this perspective, bio-based and recycled precursors can be valuable candidates toward more sustainable and circular PUs.

In this work, a facile and solvent-free procedure is setted for the formulation of an innovative and more eco-friendly PU formulation. The latter is optimized starting from a commercial polyurethane resin for LED encapsulation, whose fossil-based components have been partially substituted with bio-based and recycled ones: bis(2-hydroxyethyl) terephthalate (BHET) is directly implemented in the formulation as waste-derived material without any further treatments in conjunction with a bio-derived trifunctional polyol (Sovermol®780). To thoughtfully drive this optimization and to face all the formulation and process variables involved, a multivariate statistical approach (Design of Experiments) is successfully exploited, allowing the individuation of the most influential factors and ensuring the most economical and efficient way of analysis [4]. As a result, optimized formulation allows the partial replacement of the fossil-based raw materials, obtaining a PU with a 24.4% of green inputs and comparable to the commercial counterpart in terms of transmittance, thermal stability, and with outstanding long-term stability.

**References**

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