[P.072]

Lignin colloidal particles as adhesives in bio-composites

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Lignin presents itself as a platform for fabrication of new functional materials and green chemicals and a wide array of structural and chemical species, stemming from different sources, offers a multitude of possibilities for transforming this under-utilized natural compound into value-added products. Yet, commercially, lignin is currently still regarded either as a waste by-product or as an energy source. Using lignin to prepare colloidal particles opens up an array of possible applications, as wide ranging as Pickering emulsion-stabilizer to pesticide encapsulation.

Presented study delves into the design and construction of lignin based colloidal particles; their capacity to form densely-packed thin layers on surfaces of various biocomposites' components can result as an adhesive interfacial layer. Microemulsion-assisted precipitation of lignin was employed, as well as hydrophobic interaction-driven self-assembly, in order to prepare lignin spheres (Figure 1).
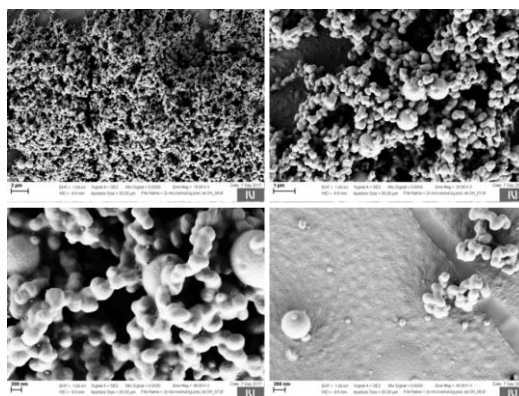

Figure 1: Scanning electron images of different lignin particles

Encapsulation of laccase enzymes within lignin particles was performed, thus demonstrating a fabrication of a lignin-based building block with an embedded polymerization trigger; enzyme polymerization of lignin particles' layers was additionally studied using quartz crystal microbalance. Surface and morphological properties of prepared lignin particles can be controlled depending on the type of fabrication approach used, allowing for the design of functional, bio-based colloidal system with adhesive properties.