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Laccase-catalyzed Polymerization for Coating and Material Modification

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The enzymatic polymerization and material modification with laccases is a promising technology especially for the coating of the natural and synthetic materials at mild conditions of temperature and pH [1]. The "in situ" enzymatic coating of several natural materials as sisal, linum, cotton and wood were performed, in a batchwise process at different temperature and pH. Small colorless aromatic compounds such as diamines, aminophenols, aminonaphtols, and phenols, were oxidized by laccase resulting in dimeric, oligomeric, and polymeric molecules [2]. The coupling and polymerizing ability of laccase was used for colored and non-colored surface modifications of the materials in order to obtain coating with water-proof, flame retardant, strength and adhesive properties. Sisal and wood were enzymatic coated with laccase using several phenols and amines. Interesting waterproof properties as well as different hues and depth of shades in the color pallet were observed. Enzymatic coating with catechol of amized cellulose fibers was also performed in the presence of laccase [3]. The LC/MS analysis of the hydrolyzed coated-cellulose confirming the presence of functionalized glucose and cellobiose units coupled to poly(catechol) molecules (m/z 580 and m/z 633). Furthermore, laccase was tested in combination with ultrasound to improve coloration of wool by "in situ" radical polymerization of catechol [4]. In the sonicated laccase/catechol system a large polymerization was observed even more than the laccase/catechol stirring system. The ultrasonic waves produce hydroxyl radicals, improve the diffusion processes and may also have positive effect on the laccase active center structure [5]. Extension of these methods to other laccase substrates, using appropriate and cost-efficient functionalization techniques, may provide a new route to environmentally friendly materials with predefined structures and properties.

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