SOLVENT-CONTROLLED MODIFICATION ON LIGNOCELLULOSIC MATERIALS VIA SI-ATRP

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Wood is a biobased material, which can be used for a wide range of applications. It possesses excellent mechanical properties and a hierarchical porous structure designed for fluid transport. The natural origin of wood comes with advantages (readily available scaffold for different applications, highly abundant, and sustainable) and drawbacks (high variability in its structure and chemical composition). The latter represents a challenge when a good control over the desired modification is needed.

SI-ATRP enables control over the distribution and size of the grafted polymer chains. It has been used to modify various materials. Cabane et al. have shown that wood can be modified by in-situ grafting of synthetic polymers enhancing the natural properties of wood [1]. SI-ATRP consists of two steps. Firstly, α-Bromoisobutyryl bromide (BiBB) reacted with the available hydroxyl groups present in the wood structure. Secondly, the polymer is grafted from the BiBB covalently bonded to the wood. It is crucial to control the distribution of the BiBB in the first step in order to be able to grow polymer chains in the desired location within the wood structure.

To control the position of the grafted-polymers into the wood structure, we investigated the utilization of various solvents possessing different wood swelling capabilities. When a good wood-swelling solvent is used (e.g. pyridine or DMF), reagents can be easily transported inside the cell wall and reacted with the hydroxyl groups from the wood biopolymers. Conversely, when a bad solvent is used (e.g. dichloromethane) the diffusion of reagents inside the cell wall is limited and the reaction essentially takes place at the cell wall surface (interface with the lumen), see Figure 1. Based on the initial localization of the ATRP initiator, we are able to govern the subsequent grafting of polymer chains inside the wood structure.

Enabling better control over the location of the functionalization in the complex wood structure will not only allow for a more efficient use of reactants, but it will also allow for a selective or targeted modification, which is an essential requirement in the design of advanced materials.

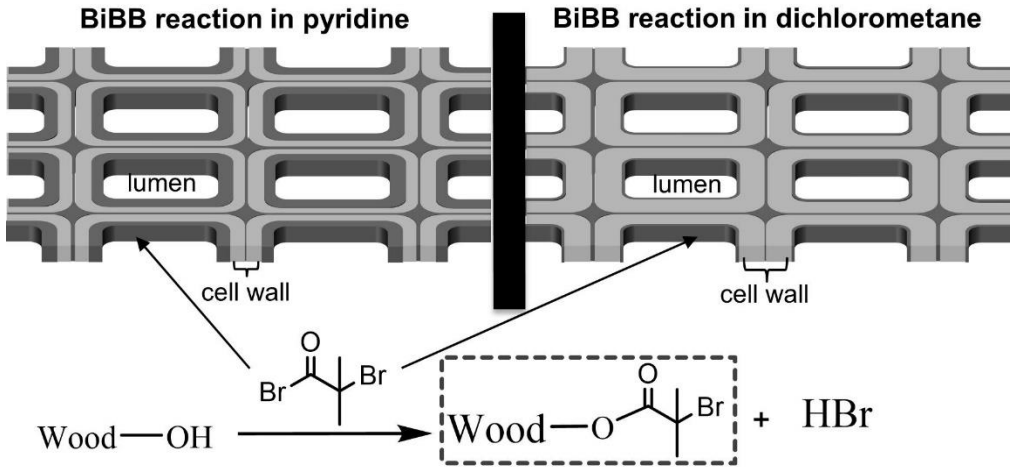

Figure 6 – Scheme of the wood after the two BiBB reactions with a good swelling solvent (pyridine) and a bad swelling solvent (dichloromethane).

[1] E. Cabane, T. Keplinger, T. Künniger, V. Merk, I. Burgert, Sci. Rep. 2016, 6, 31287.