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Interaction Between Thin Layers of Polysaccharides Studied by Quartz Crystal Microbalance with Dissipation (QCM-D)

Sergiu Coseri, Gabriela Biliuta, Andreea Laura Chibac-Scutaru

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Abstract

In this paper, the adsorption behavior of both unoxidized pullulan and its C6 oxidized correspondent, onto cellulose films derived from trimethylsilyl cellulose (TMSC), was monitored using one of the most sensitive techniques namely Quartz Crystal Microbalance with Dissipation (QCM-D). Pullulan (Pu) was converted into its oxidized counterpart using a selective oxidation protocol that targets only the C6 atom of the anhydroglycosidic unit and involves the presence of a trio of reagents: sodium hypochlorite, sodium bromide (co-oxidants), and a stable radical, *i.e.*, 2,2,6,6-tetramethylpiperidin-1-yl (TEMPO), in the role of mediator in water. The oxidation reaction was carried out at room temperature, and the resulted product, oxidized pullulan (OxP) analyzed using FTIR and ^{13}C-NMR. Buffer solutions of Pu and OxP were prepared at various pH values, and added into contact with thin cellulose layers, the interaction being in situ monitored by QCM-D. The cellulosic matrix deposited on the QCM-D crystals has been prepared by using trimethylsilyl cellulose (TMSC) as a precursor, following spin coating procedure and subsequent hydrolysis under acidic environment. Under the experimental conditions, the QCM-D studies demonstrate that at pH 5 and higher electrolyte concentrations, the highest adsorption occurs. Pullulan that hasn't been oxidized, adsorbs more effectively than its 6-carboxy derivative, which may be explained by the former's low water solubility and the potential for weak repulsive forces to form between OxP's anionic charged groups and the surface of the cellulose.

Keywords: pullulan, cellulose films, trimethylsilyl cellulose, oxidation reactions, adsorption

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