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Isolation and functionalization of nanocellulose from lignocellulosic fibres for environmental remediation and sensor applications

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Abstract

Many research attentions have been focused on the utilization of agricultural lignocellulosic biomass for the production of value-added products due to its highly abundance, biocompatibility and biodegradability. One of our major research focuses is to extract nanocellulose from lignocellulosic biomass and further used it to produce value-added functionalized materials. Conventional acid hydrolysis method was used to isolate cellulose nanocrystals (CNC) from holocellulose of oil palm empty fruit bunch (EFB) fibres and kenaf core wood. While two different homogenization systems, i.e., high speed blender and Silverson mixer, were used to defibrillate holocellulose to produce cellulose nanofibrils (CNF) [1].

The CNF produced showed rapid adsorption behavior towards cationic dyes, in which the adsorption equilibrium was achieved within 1 min of contact time. This can be due to the high surface area and surface functionalities of the CNF. In additional, by preparing CNF with different hemicellulose contents, we confirmed that hemicellulose is the major contributor in determining the adsorption performance of CNF. Maximum adsorption capacity of the CNF was 122.2 mg/g [1].

The produced CNF was used as template to synthesis CNF-silver nanocomposites via in situ synthesis of AgNPs approaches. The produced mixture was freeze-dried and turned into aerogels. The nanocomposites showed significant enhancement in the detection of Rhodamine B (RhB) in aqueous solution due to surface-enhanced Raman scattering effect (SERS) of the immobilized AgNPs clusters. The CNF–AgNPs nanocomposite showed sensitivity for detecting RhB at different concentration levels, ranging from 5×10^{-3} M to 5×10^{-7} M [3]. In addition, the nanocomposites exhibited a notable catalytic effect on the degradation of RhB in the presence of sodium borohydride. These may find applications in sensors, water purification and smart materials The produced CNF was also used as template for the formation of silver nanoprisms (AgNPRs) using silver salt, sodium borohydride, and hydrogen peroxide. The AgNPRs-CNF was found to be higher in sensitivity in the detection of organic compounds due to its greater surface plasmon resonance (SPR) [3].

Keywords: Adsorption; Catalysis; Cellulose; Nanocellulose; SERS

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