

**SURFACE MODIFICATION OF CELLULOSE NANOCRYSTAL
ISOLATED FROM OIL PALM BIOMASS USING FORMIC
ACID HYDROLYSIS AT DIFFERENT TEMPERATURE**

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ABSTRACT

SURFACE MODIFICATION OF CELLULOSE NANOCRYSTAL ISOLATED FROM OIL PALM BIOMASS USING FORMIC ACID HYDROLYSIS AT DIFFERENT TEMPERATURE

Nanocellulose has unique properties that are renewable ability, highly content of hydroxyl (OH) group on the surface and biodegradable nanomaterials which can be used in various applications. Cellulose nanocrystal (CNC) was isolated from two types of oil palm biomass, which are empty fruit bunch (EFB) and oil palm mesocarp (OPM), using formic acid hydrolysis treatment at different temperatures. CNC with good dispersion was then modified using *p*-toluenesulfonic anhydride (Ts₂O). CNC and modified-CNC from both types of biomass were characterized by using Fourier Transform Infrared (FTIR), X-ray Diffraction (XRD) and Field Emission Scanning Electron Microscope (FESEM). FTIR peaks at 1200 cm⁻¹ and 1700 cm⁻¹ were found absent after the bleaching process, indicating that lignin and hemicellulose have been removed. The modified CNC spectrum shows a new peak, which is sulfoxide (S=O) at wavenumber 1400 cm⁻¹ and 879 cm⁻¹. XRD spectra exhibit differences between the CNC and modified CNC. The modified CNC from both oil palm biomass shows a higher crystallinity index (~99%) compared to unmodified CNC (~70%) due to the presence of hydrogen bonding between OH groups in nanocellulose and alkyl groups in Ts₂O. The modified CNCs show a face-centered cubic (FCC) crystal structure. Morphology studies using FESEM show that the CNC possesses a needle-like structure. After modification, the morphology of the CNC was rearranged to be neater and denser.