# Fabrication and Characteristics of Titanium Dioxide Nanofibers/Cellulose Nanofibers Nanocomposite Film

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## 1. Introduction

Cellulose is the most abundant natural polymer on earth and exists numerously in wood, crop,and cotton. Because of its intrinsic properties like bio-compatiblity, bio-degradation, chemical stablity, non-toxicity, and renewable ability, it has the pontential to be a candidate for the sustainable material in next generation. Cellulose nanofiber (CNF) extracted from cellulose fibers has been reported that it exhibits the unique optical properties, good mechanical strength, and high aspect ratio. TEMPO-oxidation is an effective way to separate the CNF in cellulose microfibril bundles due to the formation of the regioselective replusive force between each nanobirils by modification of C6 carboxylate. Further applying the CNF in tranparent paper to be flexible substrate has become a pupular topic owing to the extraordinary feature of CNF transparent substrate such as high mechanical strength, low coefficient of thermal expansion, excellent optical tranmittance,and printablity. $TiO_2$ nanomaterials have attracted plenty intersts for its photocatalytic activity. One-dimensional nanomaterials such as nanofiber, nanowire, or nanorod are capable of achieving network struture easily that provides an effcient charge transport path to inhibit the recombination of electron-hole pairs. Moreover, nanofier-shaped materials can be probably combined with CNF to form the dense, flexible and freestanding composite film because of the accordance size between each other. Thus, we propose a simple way to prepare the $TiO_2$ NFs/CNF nanocompsite film with flexibility and photocatalytic performance. CNF is fabricated by TEMPO-oxidation method plus post-reduction by $NaBH_4$. Various $TiO_2$ NFs are sythesized by hydrothermal treatment and followed by calcination process according to our previous study. To obtain well-dispersion mixture solution of $TiO_2$ NFs and CNF, the surface modification of $TiO_2$ NFs are conducted under UV-ozone treatment improving the hydrophilicity. The charaterizations involving morpholoy, crystal struture, thermal, optical and mechanical properties were studied. The photodegradation of pollutant was measured under simulated solar light.

## 2. General Instructions

For the preparation of CNF, pulp was dispersed in 0.1 M boiling hydrochloric acid for 2 h. Wash to neutral, then transfer into the TEMPO/NaBr/NaClO solution and keep the pH value at 10 for 24 h by adding 0.5 M NaOH solution. The adequate $NaBH_4$ subsequently was added. Finally the solution was centrifuged at 9000 rpm for 20 min. The CNF hydrogel was obtained. The pristine $TiO_2$ NFs were prepared by hydrothermal method and followed by calcined at 650 $^{o}$C. For the preparation of variuos $TiO_2$ NFs/CNF nanocomposite film, $TiO_2$ solution with UV-ozone treatment was well mixed with CNF dispersion with appropriate concentration. The mixture solution was dropped into dish and placed in the accurate humidity and temperature condition until drying. The appearance of CNF film and pristine $TiO_2$/CNF film are shown in Fig. 1(a,b). The charaterizations including morpholoy, crystal struture, thermal, and mechanical properties were investigated by SEM, synchrotron X-ray spectrometer, thermogravimetric analyzer and tensile testing mechcine. The photodegradation of brillant green was measured under simulated solar light and the result is shown in Fig. 1(c).

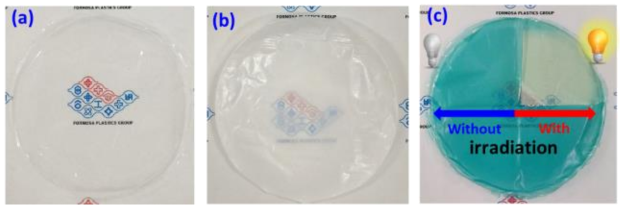


Fig. 1. Digital photograph of (a) CNF film, (b) $TiO_2$ NFs/CNF nanocomposite film, and (c) decoloration of brilliant green in nanocomposite film.

## 3. Conclusions

In present study, we prepared the $TiO_2$ NFs/CNF nanocompsite film with uniformity, flexibility, and photocatalytic performance. The charaterizations involving morpholoy, crystal struture, thermal, optical and mechanical properties were investigated. The $TiO_2$ NFs/CNF nanocompsite film exhibited the photocatalytic activity under simulated solar light.

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