Nanooptics and photonics

Obtaining of optically transparent nanocellulose films

V. A. Barbash, O. V. Yashchenko, S. V. Alushkin

[1] *National Technical University of Ukraine "Kyiv Polytechnic Institute"*
Department of Ecology and Plant Polymers Technology
Prospect Peremogy, 37, Kyiv-03056, Ukraine. E-mail: v.barbash@kpi.ua

The use of natural fibers instead of traditional reinforcement materials such as glass fibers and plastic provides several advantages including low cost, good specific mechanical properties, reduced tool wear and biodegradability [1]. Cellulose nanofibers (CNFs) have high Young's modulus, high tensile strength and low coefficient of thermal expansion. CNFs have shown great potential in several applications including nanocomposites and optically transparent functional materials. Optically transparent films from CNFs are the perfect candidate for substrates for continuous roll–to–roll processing in the future production of electronic devices, such as flexible displays, solar cells, e-papers [2].

Different schemes of sulphate bleached chemical pulp treatment for reaching optical transparency of nanocellulose films with different sequence of mechanical (grinding), chemical (hydrolysis) and physical (ultrasound) treatments were investigated. Grinding of cellulose until reaching 90 – 97 °SR in laboratory grinding complex was performed. Hydrochloric acid and sulfate acid with concentration from 5 to 65 %, duration 5 – 60 min at temperature 5 – 70 °C were used.

The resulting suspension is washed by multiple centrifugations using distilled water to remove free acid molecules.

Ultrasound treatment of cellulose was performed on apparatus with 22 kHz radiator working frequency and duration of treatment was 5 – 120 min. Aliquots of nanocellulose dispersion from 10 to 50 ml were putted in polystyrene Petri dish and evaporated at temperature 20 °C to obtain nanocellulose films. Obtained samples have width from 10 to 100 μm, density up to 1,6 g/cm^3, Young modulus up to 8,8 GPa. Positive influence of acid concentration on optical transparency of nanocellulose films was established. It was established, that nanocellulose films with transparency up to 80 % could be obtained by subsequent mechanical, chemical and physical treatment.

1. *Chirayil C. J., Mathew L., Thomas S.* Review Of Recent Research In Nano Cellulose Preparation From Different Lignocellulosic Fibers // Rev.Adv. Mater. – 2014. – 37, 20 – 28.

2. *Nogi et al.* Optically Transparent Nanofiber Paper // Advanced Materials. – 2009.- **20**, 1–4.