Structure and Properties of Oxides Incorporated Micro/Nanocellulose "Ceramics" - like Materials

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Cellulose and y its "micro/nanocellulose" forms are ones of advanced materials due to its abundance, multi-functionality, low toxicity of production and biodegradability. They are important for production of the biofuels, biochemicals, etc [1]. The range of new cellulose applications spreads from "paper electronics" to forensic examination and eco-friendly sorbents. Variety of their properties and applications is determined by the porous, micro/nanostructure morphology of the cellulose host and by the unique nature of its interaction with various chemical compounds.

This work is aimed using cool-pressing procedure to fabricate the set of "cellulose-oxide" micro/nanocomposite materials and to study their physical properties.

One set of "ceramics" - like composite materials was prepared as composition of micro/nanocellulose and luminescent oxide particles. The second set contained micro/nanocellulose and carbon nanostructures (fullerens, carbon nanotubes, flakes of the thermoexpanded graphite). The third set was made as composition of micro/nanocellulose matrix, luminescent oxide particles amd additive carbon nanostructures. Prepared composites were studied by means of scanning electron microscopy, XRD and thermogravimetric analysis, and luminescence spectroscopy.

It was found that structure of the composites prepared without oxides is formed by the plaits of near 5 – 50 μm size (crystallinity is about ~ 56%), that allowed us to characterize the samples as "ceramics – like". Structure of the micro/nanocellulose samples which contain oxide particles is similar, but the cellulose plaits are deformed and partially destroyed by oxide particles. The sizes of the last ones are from ~ 10 nm up to tens microns. Strong interaction between cellulose and carbon constituent changes the structure of carbon contained composites compared described above. Physical properties of studied materials (density, crystallinity, spectra and intensity of photoluminescence) depend both on the samples temperature (conditions of the thermal treatment) in the range 25 – 125 C and on the content of oxide or carbon components.

Obtained results showed that these composite materials are promising for creation of advanced mechanical, thermomechanical, electromechanical and optoelectronic devices, WLED, e.g.

[1] K. Nelson et al., *American process: Production of low cost nanocellulose for renewable, advanced materials applications*, Springer, 2016, pp. 267-302.

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