Fabric Modification with Nanocellulosic Fibers as Functional Carriers

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This research focuses on efficient, universal, and environmentally friendly method of fabric modification (such as dyeing, finishing, functionalization) using nanocellulosic fibers (NCF). From a practical point of view our process has been designed to be readily scalable, transferable between different fabrics and to consist of small number of technological steps. In essence, we target fabrication method where chemical processes and fabric modification are separated in space and time thus the conditions for the chemical reactions are no longer restrained by substrate and chemical proficiency of the operator. In our design, first, the chemical reactions are carried out to modify NCF using the powerful chemical arsenal developed for cellulose based materials. Then, the modification of fabric is a straightforward and quite universal process, where modified NCF are deposited from water on fabric using current manufacturing tools such as padding, spraying and printing. In our initial study we have modified NCF with attachment of reactive dye molecules to form a colored dyed-NCF solution. Different concentrations of dyed-NFC have been used to modify cotton, nylon and PET fabrics. It was observed that the color of fabrics is quite homogenous for each concentration of dyed-NCF. However, the stiffness of fabrics is increased after the addition of NCF, which can be attributed to the addition of the high-modulus NC fibers to fabrics as well as increased friction between interwoven fibers. To resolve this challenge we have used molecular bottlebrush reactive copolymer additives such as poly(Oligo Ethylene Glycol methyl ether Methacrylate- Glycidyl Methacrylate- Lauryl Methacrylate) and poly(Oligo Ethylene Glycol methyl ether Methacrylate- Glycidyl Methacrylate). Also in colorfastness test it was observed that both copolymers have a positive effect on color stability of the modified with NCF fabrics.