The aim of the project is preparation and characterization of permanent magnetic cellulose fibers preserving appropriate mechanical properties allowing their further processing into fabric or paper. An important part of the project will be selection of the optimal modifiers, which could simultaneously provide satisfactory mechanical properties and permanent magnetism of the fibers. Such cellulose fibers will be prepared by means of melt-spinning process, where N-methylmorpholine N-oxide (NMMO) acts as a direct solvent of cellulose. During the project, the modifier nanoparticles based on transition and rare earth elements will be synthesized. Such nanoparticles should exhibit strong permanent magnetism, as well as their size should be as small as possible. In order to make the modifiers nanoparticles well dispersed in cellulose solution, stable and inert to the conditions of the spinning process, the modifier nanoparticles will be covered with silica shell or thin layer of the surfactant molecules. The optimal nanomodifiers will be introduced into the cellulose solution during the fibers preparation process. The influence of magnetic NPs on the mechanical properties of the fibers will be investigated. Permanent magnetic fibers will be processed into the fabric or paper as evidence of the concept of smart materials for data information storage.

The synthesis of magnetic nanoparticles (ferrites and rare earth – transition metal) as well as bi-magnetic core/shell NPs (consisting of a hard magnetic core and a soft magnetic shell) will be carried out in a way that allows obtaining the smallest particles, taking into account the small dispersion of their size and relatively high crystallinity. The magnetic nanoparticles will be synthesized by following methods: sol-gel, co-precipitation and precipitation under hydro-/solvothermal conditions. Prepared in the previous step precursors will be subjected to the heat treatment in order to obtain desired magnetic nanoparticles. The magnetic NPs will be covered/functionalized with silica shell or surfactant. The final product will be introduced into the cellulose fibers. Fibers exhibiting permanent magnetism along with satisfying mechanical properties will be processed into fabric and also used to produce paper.

Furthermore, the obtained products will be analyzed using such techniques as: XRD (*powder X-ray diffraction*), TEM (*transmission electron microscopy*), SEM (*scanning electron microscopy*), EDS (*Energy Dispersive X-ray Spectroscopy*), DLS (*dynamic light scattering*), ZP (*zeta potential measurements*), SQUID (*Superconducting Quantum Interference Device*), tensile testing and linear density measurements

Up to date many types of soft magnetic fibers have been obtained however it is still challenging to obtain fibers exhibiting hard magnetism along with good mechanical properties. The currently obtained hard magnetic cellulose fibers cannot be processed into textiles due to their weak mechanical properties. The undertaken research aims to find suitable nanomodifiers exhibiting permanent magnetism and their successful implementation into cellulose fibers. Such cellulose fibers could be used to manufacture fabrics and papers for use in information storage devices, security cards, electromagnetic shields, etc.

Currently there are no reports on the preparation of cellulose fibers modified with bi-magnetic core/shell NPs (combination of hard magnetic core with soft magnetic shell). Therefore, I intend to synthesize such complex NPs and introduce them into cellulose fibers.

The results are expected to develop the area of smart textiles used especially for data storage and security purposes.