Preparation and characterization of carbon nanotube coatings on the surface of wood

Carbon nanotubes were very often studied in 21st century thanks to their unique properties, such as very high electrical conductivity and tensile strength or interesting chemical properties. Nowadays they are used, inter alia in composites with *polymers,* to increase mechanical strength and conductivity and also as conductive coatings. Their success induced a new branch of *carbon nanotubes/biopolymers composites*, including the main component of wood - *cellulose,* which found applications as sensor or conductive paper.

Although the described materials showed interesting properties, not much attention has been focused on *carbon nanotube composites* with bulk wood and wood based materials, or *carbon nanotube coatings* on wood. A few studies are focused on the influence of *carbon nanotubes* on properties of *Wood Plastic Composites (WPC).* It was proven that they improve mechanical strength and flame retardancy.

The proposed project is meant to create a composite made of **wood covered with carbon nanotubes** and analyze interactions between them, treating wood as complex material, and to examine their influence on durability of wood. Basing on the results regarding *nanotube dispersions and coatings* in polymer composites, it may be expected that **carbon nanotube composites with wood** will show **lower flammability** in comparison to unprotected wood. Additionally, *carbon nanotube* thin films (also known as *"buckypaper"*) show hydrophobic or even super-hydrophobic properties, which will cause water resistance and in consequence **immunity to mold and fungi decay**. Moreover *"buckypaper"* completely absorbs light, including ultraviolet (one of the largest threats for wood) and it can be treated as **UV light protection**.

Even though wood covered with *carbon nanotubes* may find various applications, first of all a series of basic research has to be conducted to understand the nature of interface between carbon nanotubes and wood, and to investigate structural and physical properties of the obtained composite.

The final aim of the project is **to obtain a uniform carbon nanotube layer on the surface of wood** which will show fire retardancy, UV light resistance and mold (also fungi) decay immunity. The uniform coverage will be prepared using *carbon nanotubes* with different lengths and widths. Moreover, various deposition methods, used inter alia in nanotechnology but also in wood conservation, will be tested to obtain a material with expected properties. Wood covered with nanotubes will be analyzed by **microscopic** (Scanning Confocal Microscopy and Scanning Electron Microscopy) and **spectroscopic** (Raman Spectroscopy and IR Spectroscopy) methods, in order to investigate thickness, composition and quality of carbon nanotube *layer* on wood surface and its degree of agglomeration. Additionally **contact angle** measurement will be conducted to examine the hydrophobic properties of composite and **electrical conductivity** tests to check the uniformity of coating.

When the uniform *carbon nanotube layer* on wood is prepared, it will be exposed to harsh conditions. At first, fire resistance will be measured, using Mini Fire Tube and Cone Calorimetry. Secondly, mold decay and UV light decomposition will be tested. After exposition, samples will be once more examined, using microscopy and spectroscopy, in order to understand and describe the mechanisms increasing resistance for various conditions. The last part of research is obtaining complete analysis of the influence of different types of *carbon nanotube coatings* (using various: types of nanotubes, deposition techniques, degree of coverage) on the properties of wood.