

Projects with Academia (2008-2012)

(last update: February/2012)

OPEN TOPICS

“Numerical analysis of multi-component building materials” (duration: 9-12 months)

This project will include the use of computational fluid dynamics (CFD) platforms to study building materials from the thermal and mechanical point-of-view. Several topics will be addressed namely the influence of composition, arrangement and packing, on the overall performance of the resulting materials. The goal is to obtain information on ways to define an optimal trade-off between thermal and mechanical performance.

“Numerical study on the human thermoregulation” (duration: 9-12 months)

This project will focus on the numerical simulation of the human thermoregulatory functions. The project will involve the study and use of thermoregulation models, for further coupling with heat and mass transfer (CFD) models of products used over the body (e.g. clothing, bedding items, footwear, helmets, seats). The goal is to develop strategies to obtain information about the products characteristics that optimise thermal comfort.

“Numerical analysis on the ventilation performance of bicycle helmets” (duration: 9-12 months)

The use of bicycle helmets is known to depend on many factors, among which the thermal comfort perception of the cyclist wearing the helmet. For that reason, it is important to study the ventilation occurring in bicycle helmets in order to identify the geometries that are more relevant for the “cooling” effect. Within this project, CFD platforms/tools will be used to study numerically the fluid flow and the heat and mass transport phenomena occurring across different helmets.

“Determination of the in vitro cytotoxicity of several vegetable extracts” (duration: 6-9 months)

The predictive value of the in vitro cytotoxicity of several natural extracts will be determined by using adequate techniques which assess the cellular damage of specific mammalian cell lines. The main objective of the work is to select the most promising extracts to be used in the development of biofunctional textiles.

ONGOING THESIS

“Numerical analysis on the mechanical and acoustic performance of building materials” (T. Correia, MSc Thesis, 2012)

In this project, CFD approaches will be used to study the mechanical and acoustic performance of building materials. The influence of parameters such as material properties, dimension and spatial arrangements will be assessed in a systematic way.

Supervision: Dr. Tiago Sotto Mayor, CeNTI

Co-supervision: Dr. J. B. L. M. Campos, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Numerical analysis of the thermal performance of building materials” (V. Oliveira, MSc Thesis, 2012)

This project will involve the use of numerical approaches to study the thermal performance of building materials. The influence of parameters such as material properties, dimension and spatial arrangements will be assessed in a systematic way.

Supervision: Dr. Tiago Sotto Mayor, CeNTI

Co-supervision: Dr. J. B. L. M. Campos, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Wind and water protection of cold weather clothing” (R. Parauta, MSc Thesis, 2012)

This project will focus on the development of manikin-based test methodologies for assessment of clothing wind and water protection. Several technologies will be made available, e.g. walk-in climate chambers, high-performance ventilation systems, thermal sweating manikin, infrared cameras, multi-sensor data loggers, etc.

Supervision: Dr. Tiago Sotto Mayor, CeNTI

Co-supervision: Dr. Olga Ferreira, Laboratory of Separation and Reaction Engineering (LSRE), Polytechnic Institute of Bragança (IPB), Portugal

“Development of novel electrochromic materials and solid-state electrochromic devices manufacture methods optimization” (M. Araújo, MSc thesis, 2012)

Over the last decades, we have witnessed an increasing commercial interest on devices based on electrochromic systems. The optical properties of these systems can be controlled by electrical stimulus, which has been proven to be useful for smart windows and auto-dimming rear view mirrors. The aim of this project is to develop novel electrochromic systems based on conducting polymers composites that exhibit good electrochromic performances (high optical contrasts, high coloration efficiency, short response times and long term durability) and compatibility with flexible substrates and economical manufacturing techniques such as screen and inkjet printing, and electrodeposition. To assemble an operational electrochromic device, besides an electrochromic material, several other functional materials are required, such as electrical conducting, ionic conducting and electroactive materials. In this project, a judicious selection and characterization of those materials will be made and different processing techniques for each will be investigated.

Supervision: Joana Fonseca, CeNTI

Supervision: Dr. Ana Cristina Freire, Chemistry and Technology Network (REQUIMTE), Faculty of Science of Porto University (FCUP), Portugal

“Determination of the antibacterial and antifungal activity of several vegetable extracts” (A. Relva, MSc Thesis)

The main objective of this work is to determine the antimicrobial activity of several vegetable extracts from natural plants. The microorganisms *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans* will be used as models. In the last stage of the work, textiles having this extracts encapsulated will be tested for their antimicrobial activity during release time.

Supervision: Dr. Carla Silva, CeNTI

Co-supervision: Dra. Ana Veloso, Chemical and Biological Engineering Department (DEQB), Coimbra Institute of Engineering (ISEC), Portugal

“Development of self-cleaning textile structures using enzymes” (A. Jesus, MSc thesis, 2011)

The main objective of this project consists in using hydrolytic enzymes for the removal of stains from fabrics. The enzymes will be permanently fixed to the substrate and could be activated during laundry or drying of the fabrics. Several commercial hydrolases will be studied and characterized in terms of their kinetic and stability properties. The interaction of some stains with functionalized and control fabric will be assessed.

Supervision: Dr. Carla Silva, CeNTI

Co-supervision: Dr. Ana Veloso, Department of Chemical and Biological Engineering (DEQB), Coimbra Institute of Engineering (ISEC), Portugal

COMPLETED THESIS

“Linkage of stable enzymes to textile structures” (S. Carvalho, MSc thesis, 2011)

In this work the covalent attachment of several enzymes to textile structures was performed. Several chemical and physical methods for generating adequate functional groups at the substrate structure were used, and subsequently proteases were linked. The addition of a spacer was also investigated. The functional substrate was afterwards tested for its washness fastness and for the enzymatic activity after each washing cycle.

Supervision: Dr. Carla Silva, CeNTI

Co-supervision: Dr. António Vicente, Department of Biological Engineering (DEB), University of Minho (UM), Portugal

“Optimisation of an intelligent system for localised cooling” (R. Rocha, MSc thesis, 2011)

As a follow-up of a 2D study on the heat and mass transfer across footwear materials (see *“Numerical study of an intelligent footwear cooling system”*, O. Neiva, 2011), this project involved 3D numerical simulations of the transport phenomena occurring in the microclimates near the skin. The goal was to study the cooling potential associated with heat and moisture removal resulting from an enhanced internal convection solution.

Supervision: Dr. T. Sotto Mayor, CeNTI

Co-supervision: Dr. J. B. L. M. Campos, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Development of electrochromic devices based on conductive metallopolymer” (M. Nunes, MSc thesis, 2011)

Electrochromic materials are functional materials which change reversibly their colour in response to an electrical stimulus. Until now they have been almost exclusively used to control transmission light in windows – smart windows and regulate light reflection in automobile rear view mirrors – auto-dimming view rear mirrors. With scientific progress towards cheaper and flexible electrochromic materials new applications have been envisaged such as paper-like displays and smart labels. In this project, novel electrochromic metallopolymer had been synthesized and their electrochromic performance evaluated. Based on those polymers, small electrochromic devices had been successfully assembled using semi-solid electrolytes.

Supervision: Joana Fonseca, CeNTI

Supervision: Dr. Ana Cristina Freire, Chemistry and Technology Network (REQUIMTE), Faculty of Science of Porto University (FCUP), Portugal

“Fabrication of inorganic films to use in electrochromic systems” (P. Costa, MSc thesis, 2011)

Nowadays, innovation has become a key point to differentiate products in today's competitive markets. Smart materials, materials which properties can be significantly changed by external stimuli, have opened up new possibilities. Among them are the electrochromic materials whose colour can be changed by an electrical stimulus. Over the years, numerous electrochromic devices with great colour contrast and exceptionally low power consumption have been reported, but durability still remains a major technologic and scientific challenge. In this project, different types of inorganic electrochromic systems had been developed and tested in order to achieve an electrochromic system with very high durability and a good colour contrast. Small electrochromic devices had been fabricated based on those optimized systems.

Supervision: Dr. Andrea Carneiro, CeNTI

Supervision: Dr. Ana Cristina Freire, Chemistry and Technology Network (REQUIMTE), Faculty of Science of Porto University (FCUP), Portugal

“Study of spray dispersions by CFD” (J. Freitas, MSc thesis, 2011)

Ultrasonic atomisers are receiving increasing attention in the field of surface engineering as tools to enhance the uniformity of depositions. When compared to conventional (nozzle-based) atomisers, ultrasonic atomisers are known to produce smaller drop sizes (which can be accurately controlled), more uniform size distributions and allow relatively large liquid flows. However, in order to maximize the spray uniformity over large surfaces, one needs to fine tune the atomiser enclosure and operating conditions. As an alternative to slow-paced experimental optimisation, numerical simulations (CFD) were developed to study the spatial dispersion of sprays along different geometries and for several operating conditions. This allowed the identification of the most promising solutions to be fine tuned experimentally.

Supervision: Dr. T. Sotto Mayor, CeNTI

Co-supervision: Dr. F.T. Pinho, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Numerical study of an intelligent footwear cooling system” (O. Neiva, MSc thesis, 2011)

Warm environments and high levels of physical activity advise the use of intelligent cooling solutions to promote thermal comfort. In this project, numerical analyses were conducted aiming at the assessment of the potential cooling power of an intelligent forced convection solution. For that purpose, coupled heat and mass transfer phenomena were implemented in a simulation model which allowed systematic studies on the influence of several fibre and textile parameters (e.g. fibre volume fraction, conductivity and density; textile tortuosity and moisture content).

Supervision: Dr. T. Sotto Mayor, CeNTI

Co-supervision: Dr. F.T. Pinho, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Study and optimisation of a wind tunnel by CFD” (S. Neves, MSc thesis, 2010)

Wind tunnels are used in very different engineering situations, from aerodynamic analysis (e.g. automotive and aerospace industry drag studies), to products thermal analysis (e.g. clothing performance studies), among others. In this project, a computational fluid dynamics approach was used to optimise the geometry of a wind tunnel, used to evaluate the thermal performance of clothing/footwear products (with thermal manikins). The influence of several parameters was analysed, e.g. test zone position, dimension and shape, as well as fan enclosure, position and operating curve, etc.

Supervision: Dr. T. Sotto Mayor, CeNTI

Co-supervision: Dr. J. B. L. M. Campos, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Development of an experimental method for assessment of footwear moisture management” (I. Gomes, MSc thesis, 2010)

The thermal comfort perception of a footwear user is the result of a complex interplay between various factors affecting the interaction between foot and footwear. One of the main factors is the presence of moisture in the shoe and its ability to promote moisture transport. In this project, an experimental (wear-trial-based) procedure was investigated to assess the performance of different types of footwear regarding moisture management. Several phenomena were studied, which resulted in a set of indexes characterizing the ability of the footwear to absorb, transfer and evaporate moisture.

Supervision: Dr. T. Sotto Mayor, CeNTI

Co-supervision: Dr. J. B. L. M. Campos, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Study and optimisation of an electrical heating laminate” (S. Couto, MSc thesis, 2010)

In activities requiring long exposures to cold such as mountain climbing, the hands (and other body parts) should be well insulated in order to optimize the climber’s performance. However, in particularly cold environments, the use of highly insulating materials may not be sufficient to assure thermal comfort at body extremities and, thus, alternative solutions (e.g. namely electrically heating bands) may be required. In this project, a numerical study on the heat transfer through a multi-layer textile containing an electrical heating band was conducted. Several parameters were analysed for different environmental conditions, namely heating wire distribution, heating performance versus power consumption, battery duration, effect of metallization, etc.

Supervision: Dr. T. Sotto Mayor, CeNTI

Co-supervision: Dr. J. B. L. M. Campos, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Numerical simulation of heat and mass transfer – practical applications” (B. Gonçalves, MSc thesis, 2009)

The heat losses from the human body depend on several factors among which the garment properties (e.g. insulation, air permeability) and the position, geometry and exposure of the body region in question (e.g. torso, arms, head, feet, etc.). The local heat losses from a clothed human can be determined in realistic conditions using thermal manikins and climate chambers. Alternatively, numerical approaches can be used after proper validation of the numerical models. In this project, a computational fluid dynamic (CFD) approach was used to simulate the fluid flow and the heat transfer phenomena occurring when a foot is exposed to cold convective currents. The obtained results compare very favourably with experimental results obtained with a thermal foot manikin. The influence of several parameters were studied namely the air velocity and temperature of the convective currents, existence or absence of natural convection, and turbulence parameters.

Supervision: Dr. T. Sotto Mayor, CeNTI

Co-supervision: Dr. J. B. L. M. Campos, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Development of an experimental method for assessment of socks performance with a sweating thermal manikin” (C. Santos, MSc thesis, 2009)

The thermal performance of clothing and footwear products should be measured using thermal sweating manikins, which mimic the human geometry and shape and, thus, can capture the effect of product design, fit, layer number, etc.. In this project, an experimental procedure was developed (based on equivalent standardised procedure for clothing) to inform on the evaporative resistance of socks. Several factors were analysed, e.g. total and local sweat rate, test time, donning procedure, measurement order, etc.

Supervision: Dr. T. Sotto Mayor, CeNTI

Co-supervision: Dr. J. B. L. M. Campos, Transport Phenomena Research Centre (CEFT), Faculty of Engineering of Porto University (FEUP), Portugal

“Multilayer structures for Moisture Management” (Manuela Madeira, MSc thesis, 2009)

Thermal comfort is of major importance in the overall comfort perception of a human being. As clothing research advances, higher performances are possible with custom-made garments. Users ask for materials to keep them warm in cold environments, fresh in warm climates, while assuring low humidity near the skin. This means materials and products are required to have good performances in terms of moisture management, i.e. absorption and transfer of sweat away from the skin. In this project, several membranes, made of different materials and from diverse manufacturers, were tested to obtain information about the water vapour transmission rate and breathability. Different combinations of layers plus membranes (laminates) were studied and analysed.

Supervision: Dr. Carina Machado, CeNTI

Supervision: Dr. Teresa Sena Esteves, Institute of Engineering of Porto University (ISEP), Portugal

Co-supervision: Dr. Paulo Silva, ISEP

“Development of a new bleaching process using ozone” (A. Cardoso, MSc thesis, 2009)

The purpose of the study was to develop a new bleaching process for protein textile substrates, using ozone as the oxidizing agent. This study follows the necessity of using environmental friendly processes, since the conventional bleaching methods normally used in textile industries are responsible for high consumptions of water and energy, as well as hazardous chemicals. Response surface methodology was used as an optimisation strategy to attain the set of operating conditions that maximize the whiteness degree of the textile substrate used. The characterization tests performed confirmed that ozone is a powerful oxidizing agent and that no damage was observed on the keratin bleached textile fibres (by FT-IR and SEM analysis and tensile strength tests) when comparing with the control sample (without any treatment). The technology proposed in the study has enabled significant reductions in the consumption of bleaching agents and other auxiliary chemicals, as well as on the consumption of water and energy, without compromising the quality and whiteness degree of the bleached textile substrate.

Supervision: Dr. Carla Silva, CeNTI

Co-supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

“Study of a biotechnological process for the coloration of textile substrates” (A. Barros, Graduation thesis, 2009)

The project intended to develop an alternative environmentally friendly process for colouring wool fibres. The aim of the study was to use harmless compounds, avoiding the use of dyes and other chemicals used in the traditional dyeing process and all the problems associated with this type of recalcitrant compounds. The alternative method studied is based on the reaction of an enzyme with various naturally occurring phenolic compounds.

To maximize the attained results and minimize the number of assays performed, the technique of Design of Experiments (DOE) was used for planning the experiences. This technique permits the modeling and optimization of the processes, involving factors of entry (discrete or continuous) that can be checked by the experimenter, and one or more factors of response. The experimental data are used to obtain an empirical model that relates the factors with the answers.

Supervision: Dr. Carla Silva, CeNTI

Co-supervision: Dr. Ana Cristina Rodrigues, Polytechnic Institute of Viana do Castelo (IPVC), Portugal

“Production and characterization of cosmetic textiles” (R. Coelho, MSc thesis, 2010)

The main objective of this project was to produce textiles compatibles with the skin, which encourage their good condition and functioning. Currently textiles are emerging in the clothing area that "promises" an improvement of skin condition, reflected for example in the improvement of skin hydration. These products have not yet provided, at least, a basis for verification of such "promised" effects. Therefore, it becomes necessary to develop a methodology for measuring skin properties and for simulating the use of the textiles in order to verify the variation of skin properties, such as hydration and transepidermal water loss, which were studied along this project. In the development of this project cotton was used as substrate, which was subsequently impregnated with potentially hydrating solutions, by Padding, Ultrasonic Spray and Manual Spray. The prepared samples and a commercial textile for comparison were used close to the skin, and the hydration and transepidermal water loss were measured before and 6 hours after placing the samples on the forearm.

Supervision: Dr. Carla Silva, CeNTI

Co-supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

“Development of novel ultrasonic spraying surface treatments and comparison with conventional textile impregnation methods” (A. Silva, MSc thesis, 2010)

The main objective of this project consisted in the development of a new technology for treatment of textile surfaces, through the deposition of functional agents by ultrasonic spray. In order to validate the technology in terms of final performance, the results obtained were compared with a conventional technology of functionalization, the pad method. On the basis of this study was the necessity to reduce the quantity of raw materials applied in the current textile processing, diminishing equally the environmental impact associated to it. As textile substrate, cotton fabric was used, over which were applied products that confer properties such as flame retardance and antimicrobial properties. Subsequently, the respective tests of characterization according to the functionality being studied were carried out. The results obtained by the two methods revealed a similar performance, highlighting the advantages of the deposition by ultrasonic spraying.

Supervision: Dr. Carla Silva, CeNTI

Co-supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

“Development of rapid tests for detecting antimicrobial activity on textiles” (P. Castro, Graduation thesis, 2010)

In this work the development of improved techniques for determining the interaction of textiles substrates and microorganisms was carried out. Several commercial kits were used and its capacity for evaluating the antibacterial activity of the substrate against a gram positive bacteria (namely *Staphylococcus aureus*) was compared with the normalized method, the ISO 20743 (Textiles -- Determination of antibacterial activity of antibacterial finished products). The results attained allowed to conclude that the antibacterial activity was similar for the normalized method and the commercial kits, and an expedite method could be built to evaluate this property.

Supervision: Dr. Carla Silva, CeNTI

Co-supervision: Dr. Björn Johansson, Department of Biology (DB), University of Minho (UM), Portugal

“Development of materials with improved gas barrier properties” (A. S. Silva, MSc thesis, 2009)

Materials with improved barrier properties have a wide range of applications namely food and beverage packaging, aeronautics, electronics, among others. The necessity of developing more effective barrier materials has given rise to different strategies to achieve them and a lot of research is being done in this field. Nanocomposites, particularly those based on nanoclays have been found to significantly improve barrier properties and have some advantages over traditional materials. In this project multilayer films based on nanoclays were developed employing self-assembly Layer-by-Layer technique (LbL) and the barrier properties to helium were evaluated.

Supervision: Dr. Andrea Carneiro, CeNTI

Supervision: Dr. Ana Cristina Freire, Chemistry and Technology Network (REQUIMTE), Faculty of Science of Porto University (FCUP), Portugal

“Development of innovative textile materials with improved thermal insulation” (B. Moura, MSc thesis, 2009)

Nowadays, the thermal insulation in adverse climatic conditions is mainly assured by down based products or special synthetic fibres based on polyester, however all these products are very thick to guaranty the necessary thermal insulation. With this project we aim at the development of innovative textile materials with improved thermal insulation to achieve thinner and lightweight clothing products with similar or improved thermal insulation of those traditional products. The main strategy was incorporate low thermal conductivity materials into different thin and lightweight textile substrates by different methodologies, monitoring the most relevant physical, chemical and thermal properties of the developed materials.

Supervision: Dr. Andrea Carneiro, CeNTI

Supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

Synthesis and characterisation of nanoparticles with low thermal conductivity” (R. Neto, Graduation thesis, 2009)

The aim of this project was the development of a methodology for synthesis of materials with very low thermal conductivity. The work focused on the synthesis of silica based materials by sol-gel reactions in different experimental conditions namely reaction time, temperature and concentration of the reagents. Sol-gel is a wet-chemical technique commonly used in materials science and ceramic engineering. In general require time consuming optimization studies, but it is very versatile and, usually, very economic when compared with alternative techniques. The developed materials were characterized by several techniques namely infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and X-ray microanalysis (EDS), thermogravimetric analysis (TGA) and solid state nuclear magnetic resonance (NMR) of ^{13}C and ^{29}Si .

Supervision: Dr. Andrea Carneiro, CeNTI

Supervision: Dr. Ana Cristina Freire, Chemistry and Technology Network (REQUIMTE), Faculty of Science of Porto University (FCUP), Portugal

“Development of high thermal insulation textile structures” (L. Almeida, MSc thesis, 2010)

The aim of this project was the development of a thin, lightweight and high insulation textile structure to be used in clothing products suitable for demanding outdoor cold weather conditions. In this work different textile substrates with high thermal resistance were selected from the results obtained in a previous work and a hybrid multilayer structure was developed by the combination of different materials. The materials selection and the layer arrangement were done with the objective to minimize heat loss by conduction, convection and radiation phenomena and hence improve the textile structure thermal resistance. During the development thermal resistance of the materials were monitored by Sweating Guarded-Hotplate method (commonly named Skin Model) in accordance with the standard ISO 11092:1993.

Supervision: Dr. Andrea Carneiro, CeNTI

Supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

“Optimisation of a synthesis methodology for the production of low thermal conductivity nanoparticles” (D. Barros, MSc thesis, 2010)

In this work silica particles with nano- and micrometer dimensions were prepared by procedures based on the sol-gel method, using different silica precursors and pH conditions, in the presence or absence of templates. The influence of several reaction parameters, such as time of acid hydrolysis and basic condensation, type and concentration of base on the morphology, structure, textural properties and chemical composition of the materials was studied. The developed materials were extensively characterized by several characterization techniques namely infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and X-ray microanalysis (EDS), powder X-ray diffraction (PXRD), thermogravimetric analysis (TGA), solid state nuclear magnetic resonance (NMR) of ^{13}C and ^{29}Si and nitrogen adsorption-desorption isotherms at $-196\text{ }^{\circ}\text{C}$.

Supervision: Dr. Andrea Carneiro, CeNTI

Supervision: Dr. Ana Cristina Freire, Chemistry and Technology Network (REQUIMTE), Faculty of Science of Porto University (FCUP), Portugal

“Development of formulations for innovative textiles finishes” (A. Silva, MSc Thesis, 2009)

The main objective of this work is to develop and implement a novel technology of textile finishing that allows to obtain textile products with the easy-clean functionality or that are water and stain repellent. The hydrophobic and oleophobic properties, as well as the consistency of the finishing of the impregnated material were characterized using contact angles and whiteness degree. The fastness of typical stains such as wine, coffee, olive oil and ketchup, was evaluated. A quick-screening test to the repellence capacity of the finishing was also made based on a 3M test.

Supervision: Dr. José Santos, CeNTI

Co-supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

“Development of Surface Treatments to Improve Water and Oil Repellency in Textiles” (A. Sampaio, MSc Thesis, 2009)

The present project is a continuation of the project “Development of formulations for innovative textiles finishes”, where formulations for treating textile substrates were developed to obtain water and oil repellent properties. Thus, the main objectives of this project are the improvement and optimization of the solutions created previously, by introduction of other components and optimization of their quantities to obtain a high-quality performance at low cost. The prepared substrates were then evaluated by the following characterization tests: repellency tests (water and oil), contact angles, whiteness and washing fastness.

Supervision: Dr. José Santos, CeNTI

Co-supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

Development of UV curable functional polymeric coatings (V. Mendes, MSc Thesis, 2010)

The aim of this project consists in the development of polymer coatings curable by ultraviolet (UV) light. The project is divided in three stages, consisting in the functionalization of different textile materials in order to promote characteristics as hydrophobicity and oleophobicity, hydrophilicity and flame resistance. The first stage consisted in the promotion of hydrophobicity and oleophobicity characteristics on cotton fabrics. The second feature studied was the hydrophilicity of textile materials coated with polyolefins. On the third and last stage, flame retardant characteristics were promoted on cotton textiles by the photopolymerization of a formulation. With this project it was found that the use of photopolymerization multiple features on textile substrates can be promoted, including the promotion of hydrophobic and oleophobic characteristics on cotton, hydrophilic characteristics in polyolefins and flame retardant characteristics in cotton.

Supervision: Dr. José Santos, CeNTI

Co-supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE)), Faculty of Engineering of Porto University (FEUP), Portugal

Development of Biomimetic Coatings inspired on the adhesion properties of Gecko Foot Surface (O. Rocha, MSc Thesis, 2010)

Biomimetic research is a scientific initiative that seeks to identify and replicate adaptive biological attributes with potential technological applications. In this work, three different coatings were developed. Despite their differences, they all are biomimetic coatings from natural adhesive systems with reversible or permanent properties under dry and wet conditions. Coatings were then applied in different polyurethane based substrates, in order to improve their wet and dry grip conditions. For this purpose, two different approaches were tried: the preparation and coating of the substrates with a commercial formulation based on gecko's foot concept and the synthesis of two different polymers and subsequent coating of the substrates. The results indicate that all the coatings developed improve the wet and dry grip of the studied substrates.

Supervision: Dr. José Santos, Joana Branquinho, CeNTI

Co-supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

“Incorporation of nanomaterials onto textile substrates” (A. Gonçalves, MSc thesis, 2008)

The main objectives of this work were the modification and characterization of multiwalled carbon nanotubes (MWCNTs), their subsequent incorporation in two textile substrates, and the assessment of the functional properties of the new materials prepared. The surface chemistry of the carbon nanotubes was modified by oxidation in the liquid phase with HNO_3 , oxidation in the gas phase and by thermal treatment. The surface chemistry of the prepared materials was characterised by several techniques and the incorporation was performed following the standard procedure for dyeing the respective substrates, where dye solutions were replaced by MWCNTs water dispersions. The hydrophobicity, flame retardancy, electric conductivity and wash fastness of the prepared textile samples were determined.

Supervision: Bruno Jarrais, CeNTI

Supervision: Dr. Fernando Pereira, Laboratory of Catalysis and Materials (LCM/LSRE), Faculty of Engineering of Porto University (FEUP), Portugal

“Hydro(oleophobic) nanosilicas incorporated onto textile finishing formulations” (A. Monteiro, Graduation thesis, 2009)

In this work, the main objective was the preparation of new functional textiles, namely cotton textiles, with superhydro(oleophobicity) properties through the anchoring of functionalized silica nanoparticles. Several new methodologies were developed in such a way as to promote and optimize the hydro(oleophobicity) properties of the cotton fibres. These methodologies contain both in situ methods and post-grafting procedures. The functionalized and the final materials were characterized by several techniques in order to access their morphological and chemical nature and the hydro(oleophobicity) was evaluated through the measurement of contact angles between the final textile materials and water and oil, respectively. The superhydro(oleophobicity) in some of the textiles materials was achieved.

Supervision: Bruno Jarrais, CeNTI

Supervision: Dr. Ana Cristina Freire, Chemistry and Technology Network (REQUIMTE), Faculty of Science of Porto University (FCUP), Portugal