ISIS@MACH ITALIA

Science and Technology Facilities Council
ISIS Neutron and Muon Source

Experiment Proposal

Experiment number GP2024029

Principal investigator	Miss Paola Amazio, Next Technology Tecnotessile, ITALY
Co-investigator (*)	Dr Gennaro Gentile, IPCB CNR, ITALY
Co-investigator	Dr Marino Lavorgna, CNR, ITALY
Co-investigator	
Co-investigator	
Co-investigator	
Co-investigator	
Co-investigator	
Co-investigator	
Experiment title	Morphological characterization of sustainable coatings containing antimicrobial nanoparticles applied on different kind of textiles for personal protective equipment (PPE)
MRF Instrument	**SEM FEI**
Access Route	Direct Access
Science Areas	Engineering, Materials
Sponsored Grant	None
Grant Title	-
Start Date	-
Similar Submission?	-
Industrial Links	Next Technology Tecnotessile
Non-Technical Abstract	The project aims to develop efficient and multifunctional antimicrobial nanocoatings, containing TiO2 nanoparticles that have demonstrated an exceptional antimicrobial ability at lab scale. Two sustainable approaches will be applied: 1) customised core/shell and advanced functional nanoparticles and 2) hybrid fibre-nanoparticles (using sustainable bio-based cellulose materials and nanoparticles) will be realized. The production of coating will follow a sustainable-by design approach that considers both toxicity and environmental impact. The approaches will find applications in Personal Protective Equipment (PPE). The SEM morphological analyses will allow to investigate the distribution of the coating on textile and the nanoparticles between fibers. Moreover, SEM analyses allow us to measure the dimension of nanoparticles and fibers.
Publications	-

Days requested: 3
Previous GP Number: -
DOI: -
Sponsor: -
Grant Number: -
Finish Date: -

ISIS neutron and muon source

E-platform: No

Instruments	**Days Requested:**
Access Route	**Previous RB Number:**
Science Areas	**DOI:**
Sponsored Grant	**Sponsor:**
Grant Title	**Grant Number:**
Start Date	**Finish Date:**
Similar Submission?	
Industrial Links	

Sample record sheet

Principal contact Dr Gennaro Gentile, IPCB CNR, ITALY
MRF Instrument **SEM FEI** **Days Requested:** 3
Special requirements:

SAMPLE

Material	5 coated polyester samples: polyester + TiO2 nanoparticles	5 coated cotton samples: cotton + TiO2 nanoparticles	5 coated polyamide samples: polyamide + TiO2 nanoparticles
Formula	5 coated polyester samples: polyester + TiO2 nanoparticles	5 coated cotton samples: cotton + TiO2 nanoparticles	5 coated polyamide samples: polyamide + TiO2 nanoparticles
Forms	Liquid	Solid	Liquid
Volume	1 cc	1 cc	1 cc
Weight	1 g	1 g	1 g
Container or substrate	-	-	-
Storage Requirements	-	-	-

SAMPLE ENVIROMENT

Temperature Range	- K	- K	- K
Pressure Range	- mbar	- mbar	- mbar
Magnetic field range	- T	- T	- T
Standard equipment	-	-	-
Special equipment	N/A	N/A	N/A

SAFETY

Prep lab needed	Yes	Yes	Yes
Sample Prep Hazards	no	no	no
Special equip. reqs	-	-	-
Sensitivity to air	No	No	No
Sensitivity to vapour	No	No	No
Experiment Hazards	no	no	no
Equipment Hazards	-	-	-
Biological hazards	no	no	no
Radioactive Hazards	no	no	no
Additional Hazards	-	-	-
Additional Details	-	-	-
Sample will be	Disposed by IS	Disposed by IS	Disposed by IS

Morphological characterization of sustainable coatings containing antimicrobial nanoparticles applied on different kind of textiles for personal protective equipment (PPE).

Background and Context

The catastrophic pandemic of the 2020 has attracted our attention towards the spread of harmful pathogens facilitated by high traffic surfaces, highlighting the importance and urgency of an economically and environmentally sustainable solution for antimicrobial surface as a potential strategy to mitigate the spread of disease outbreaks. Nanoparticle filled coatings, with recognised effectiveness against bacteria, viruses, and fungi, are valuable candidates for developing antimicrobial surface and minimising the surface adhesion of pathogens. However, due to the many technical challenges, including difficulty to develop nanocoatings with a long-term antimicrobial capability, durability under real conditions and safety assurance, their application at industrial level is still limited. The project aims to develop efficient and multifunctional antimicrobial nanocoatings, containing TiO2 nanoparticles that have demonstrated an exceptional antimicrobial ability at lab scale. Two sustainable approaches will be applied: 1) customised core/shell and advanced functional nanoparticles and 2) hybrid fibre-nanoparticles (using sustainable bio-based cellulose materials and nanoparticles) will be realized. The production of coating will follow a sustainable-by design approach that considers both toxicity and environmental impact. The approaches will find applications in Personal Protective Equipment (PPE). The involved textiles are made of the main fibers used for PPE: cotton, polyester and polyamide. Plasma treatment is necessary to activate the textile surface and allow a better adhesion with the coating textile, that is applied through impregnation. The morphology of the fabrics and the homogeneity of the coatings will be evaluated by optical and scanning electron microscopy. The activity will start with the experimental tests to characterize textile structure before treatment, different type of textile structures and coating deposition will be studied. The SEM morphological analyses will allow to investigate the distribution of the coating on textile and the nanoparticles between fibers. Moreover, SEM analyses allow us to measure the dimension of nanoparticles and fibers.

2. Proposed experiment

SEM will be used for examining the surface morphology and structures of textile surfaces. Next Technology Tecnotessile will product different samples with different textile support. Using the SEM FEI equipment available at IPCB, 15 samples of coatings applied with different processing conditions and on different textile substrates will be analyzed to evaluate best coating formulations and coating application conditions.

3. Summary of previous experimental proposals or characterisation

No previous experiments have been carried out on these samples

4. Justification of experimental time requested

We have requested the SEM FEI equipment available at IPCB CNR to evaluate to obtain info on the morphology of the three different textiles, namely cotton, polyamide and polyester, before and after treatment. It is proposed to measure n. 15 samples, (3 sample before treatment for cotton and polyester and polyamide textiles), 4 coated polyester samples (2 for first coating treatment, 2 for second coating treatment) 4 coated polyamide samples (2 for first coating

treatment, 2 for second coating treatment), 4 coated cotton samples (2 for first coating treatment, 2 for second coating treatment) .For SEM analysis, textile samples will be mounted on aluminium stubs. SEM analysis will be performed at suitable conditions useful to evaluate the coating morphology at different scale lengths. After discussion with the instrument scientist, we request 3 days of SEM FEI access, for a fully and thorough morphological characterization of the materials. The foreseen beam time accounts set up and for the data collection on the samples.

References

Qiu & Netravali, Comp. Sci. Tech., 72 (2012) 1588
Coronavirus: How the pandemic has changed the world economy (BBC, 2021)
Kumaravel et al. Antimicrobial TiO2 nanocomposite coatings for surfaces, dental and orthopaedic implants, Chem. Eng. J. 2021, 416, 129071
EP 2519348 - Method of production of photocatalytic powder comprising titanium dioxide and manganese dioxide active under ultraviolet and visible light.
S.P. Deshmukh, et al. Silver nanoparticles as an effective disinfectant: A review Mater. Sci. Eng. C Mater. Biol. Appl. 2019, 97, 954
V.M. Luna-Pabello et al. Effectiveness of the use of Ag, Cu and PAA to disinfect municipal wastewaster, Environ Techno. 2007, 30, 129
Norrrahim et al. Emerging development of nanocellulose as an antimicrobial material: an overview Mater. Adv., 2021,2, 3538
I. Kitsou, et al. Development of SiO2@TiO2 core-shell nanocatalyst for catalytic applications, Appl. Surf. Sci. 2018,441,223
Alternative material to pure ZnO, Appl. Surf. Sci, 2019, 473, 40
Kitsou, et al. Synthesis and characterization of ceria-coated silica nanospheres: their application in heterogeneous catalysis of organic pollutants, SN Appl. Sci., 2019, 1, 1557