19th International Technical Footwear Congress
February 03-05, 2016, Chennai, INDIA
www.uitic-congress.cleindia.org/

Offical Event of
UITIC
INTERNATIONAL UNION OF SHOE INDUSTRY TECHNICIANS

Organizer
Council of Leather Exports

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FOOTWEAR FUNCTIONALIZED AT NANOSCALE

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CTCP, Portuguese Footwear Research Centre

ctcp centro tecnológico do calçado de portugal

Outline

1 | CTCP - Portuguese Footwear Technological Centre

2 | Footwear Industry: New Concepts of Products
R&D&I
R&D Nano Projects

3 | NANOFOOT: Introduction
Partners
Research lines
3.1 leathers and microfibers
3.2 Eva nanocomposites
3.3 Nano technological Footwear
3.4 Human Safety and Environmental Impact

1 | CTCP - Portuguese Footwear Technological Centre

- Portuguese reference Centre for footwear research and technological innovation
- CTCP is a private non-profit organization
- Founded in 1986
- More than 400 Associated
- multidisciplinary team of 50 professionals (Internal Technical Personnel & external consultants)

ctcp centro tecnológico do calçado de portugal

1 | CTCP - PORTUGUESE FOOTWEAR TECHNOLOGICAL CENTRE

ctcp centro tecnológico do calçado de portugal

2 | Footwear Industry: New Concepts of products

2 | FOOTWEAR INDUSTRY: R&D&I

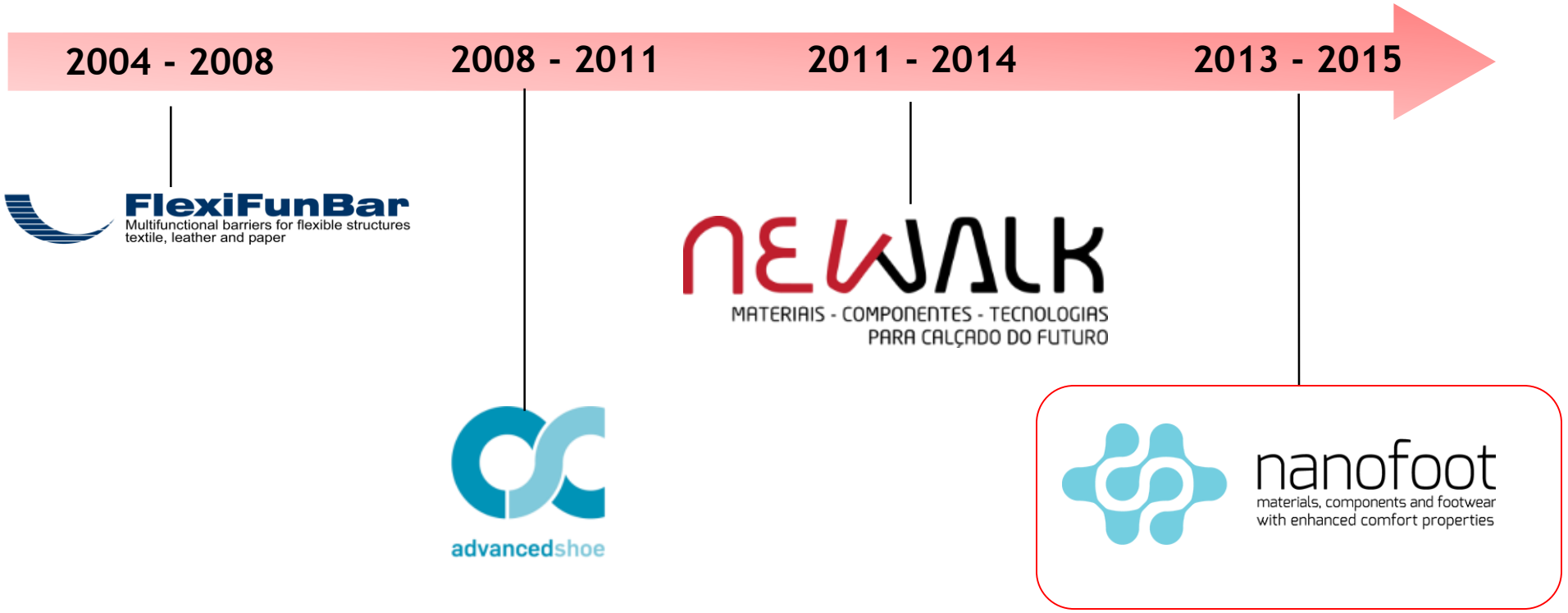
1. MATERIALS AND COMPONENTS
ADVANCED, **NANOMATERIALS** AND BIOMATERIALS

2. NEW PRODUCTS AND DESIGN
DIRECTED TO MARKET SEGMENTS WITH REQUIREMENTS IN HEALTH, WELLBEING, SAFETY, SUSTAINABILITY, ETC.

3. EQUIPMENT'S AND PROCESSES
NANOTECHNOLOGIES, ROBOTIZATION, BIOTECHNOLOGIES, FLEXIBILITY PRODUCTION, TECHNOLOGIES

4. SUSTAINABILITY & RESPONSIBLE DEVELOPMENT
MODERNIZATION AND SOCIAL INTEGRATION, ENVIRONMENTAL AND ENERGY EFFICIENCY; GLOBAL COMPETITIVENESS

2 | FOOTWEAR INDUSTRY: R&D NANO PROJECTS



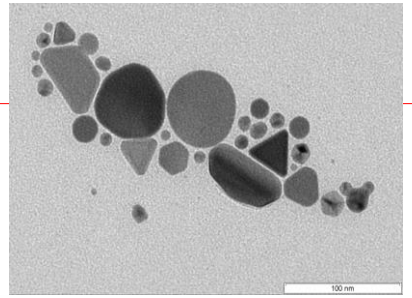
3 | NANOFOOT: INTRODUCTION

nanofoot
materials, components and footwear with enhanced comfort properties

WHY NANO?

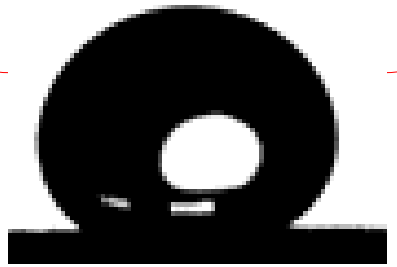
NPs CHARACTERISTICS

- SIZE BETWEEN 1 – 100 NM
- LARGE SPECIFIC SURFACE AREA
- FASCINATING AND USEFUL PROPERTIES
- STRUCTURAL AND NON-STRUCTURAL APPLICATIONS
- STRONGER, MORE DUCTILE MATERIALS
- CHEMICALLY VERY ACTIVE MATERIALS



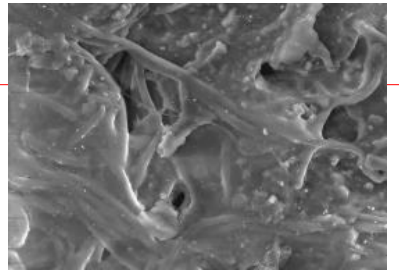
NPs PROPERTIES

- SELF-HEALING
- SELF-CLEANING
- ANTI-STAINING
- ANTIBACTERIAL
- ANTIFUNGAL
- ANTIREFLECTION
- BONDING/ADHESION
- HYDROPHOBICITY



MANUFACTURER OF:

- SCRATCHPROOF EYEGLASSES
- PAINTS
- CERAMIC COATINGS FOR SOLAR CELLS
- COSMETIC PRODUCTS
- FOOD PACKAGING
- MEDICAL DEVICES
- MEDICINE
- NANOCOMPOSITES
- FABRICS AND TEXTILES
- MULTIFUNCTIONAL MATERIALS



3 | NANOFOOT: INTRODUCTION

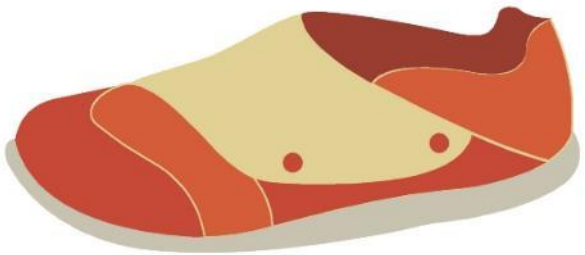
nanofoot
materials, components and footwear with enhanced comfort properties

SHOE IS A CLOSED SYSTEM THAT SHOULD AVOID

- HUMIDITY ACCUMULATION AND TEMPERATURE INCREASE
- BACTERIAL & FUNGAL GROWTH
- GENERATION OF MALODOURS
- ELECTROSTATIC CHARGES ACCUMULATION
- SAFETY PROBLEMS
- DISCOMFORT AND HEALTH PROBLEMS

BY EXPLORING

- NPS ON DEVELOPMENT OF NEW MATERIALS
- NEW CONCEPTS OF PRODUCTS
- NEW FOOTWEAR CONSTRUCTIONS



3 | NANOFOOT: INTRODUCTION

nanofoot
materials, components and footwear with enhanced comfort properties

NANOFOOT IS AN EUROPEAN R&D PROJECT TO DEVELOP ADVANCED AND INNOVATIVE NANOTECHNOLOGY BASED SOLUTIONS FOR:

LEATHERS & MICROFIBERS

WITH ANTIBACTERIAL AND ANTIFUNGAL RESISTANCE

NANO PROCESSING AND COATING PRODUCTS

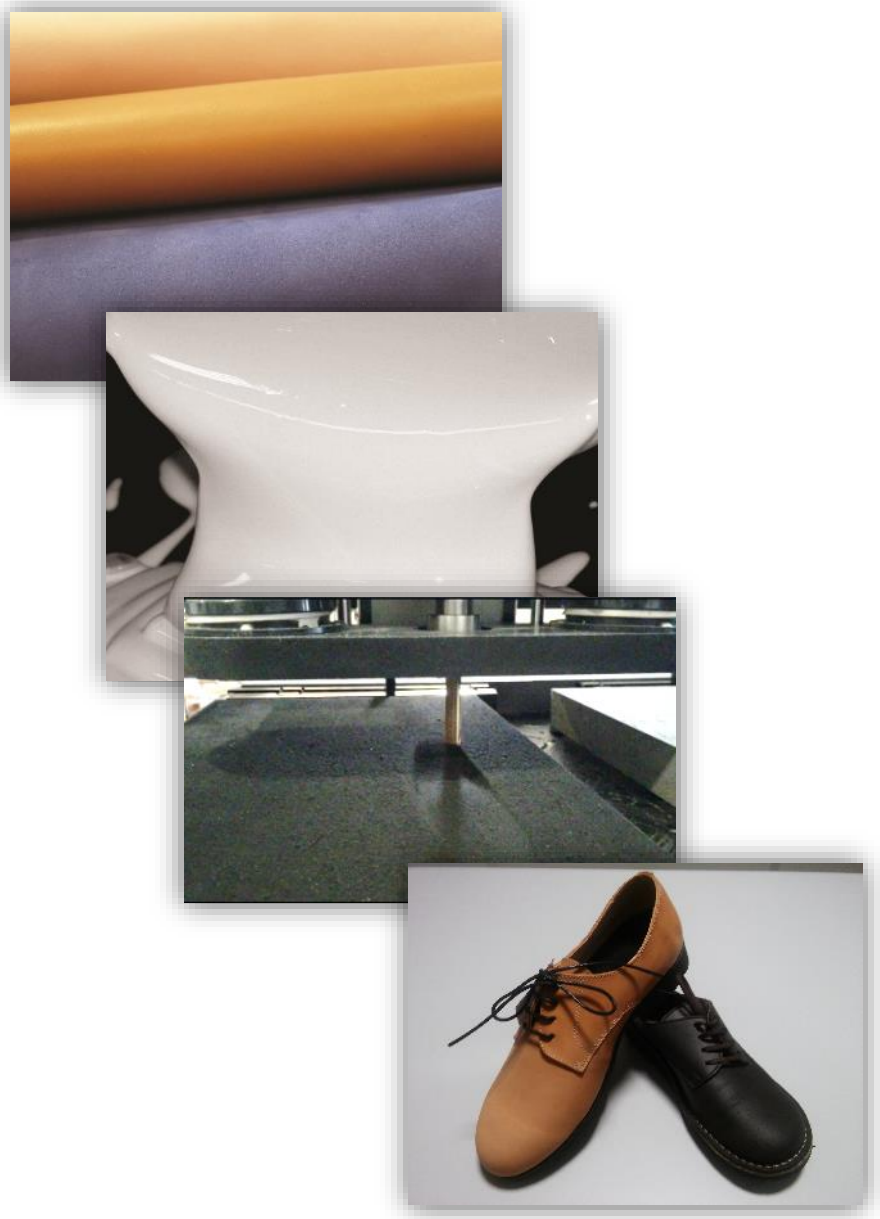
FOR LEATHER AND MICROFIBERS

EVA POLYMERS COMPONENTS

THERMAL/ELECTRICAL CONDUCTIVITY PROPERTIES

NANO TECHNOLOGICAL FOOTWEAR PRODUCTS

VEGAN AND LEATHER BASED WITH HIGHER PROPERTIES



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POLYMERS COMPONENTS THERMAL/ELECTRICAL CONDUCTIVITY PROPERTIES

FOOTWEAR PRODUCTS

VEGAN AND LEATHER BASED WITH HIGHER PROPERTIES

3 | NANOFOOT: PARTNERS

nanofoot
materials, components and footwear with enhanced comfort properties

- SME's

Curtumes A Veneda, lda.

INDINOR
INDÚSTRIAS QUÍMICAS, SA

EVATHINK

TODOPARA SUSPIES

CAMMINALEGGERO
Animal free shoes

- RTD's

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INESCOP
INSTITUTO TECNOLÓGICO DEL CALZADO Y CONEXAS

U.PORTO
FACULDADE DE CIÊNCIAS UNIVERSIDADE DO PORTO

ITIA
Istituto di Tecnologie Industriali e Automazione
Consiglio Nazionale delle Ricerche

- Financial Support

European Commission
Research Executive Agency

SEVENTH FRAMEWORK PROGRAMME

3 | NANOFOOT: RESEARCH LINES

nanofoot
materials, components and footwear
with enhanced comfort properties

3.1 LEATHERS AND MICROFIBERS

3.2 EVA NANOCOMPOSITES

3.3 NANO TECHNOLOGICAL FOOTWEAR

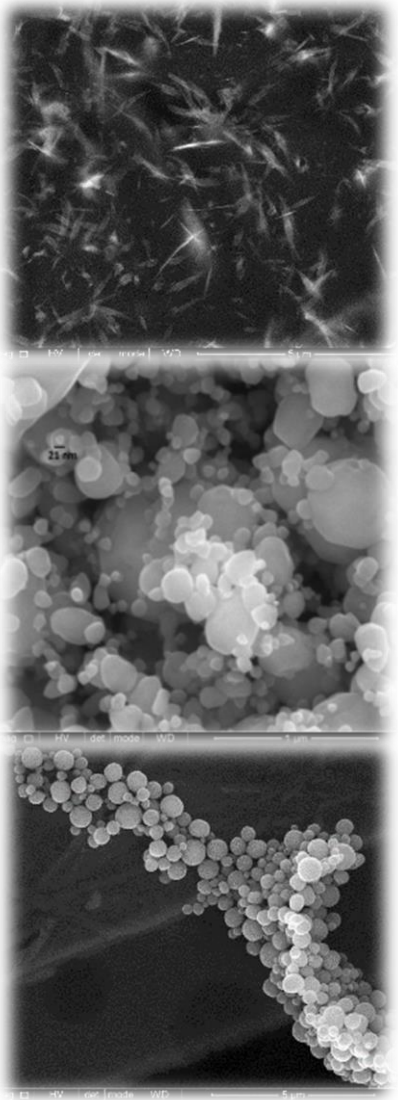
3.4 HUMAN SAFETY AND ENVIRONMENTAL IMPACT

3.1 | NANOFOOT: LEATHER AND MICROFIBERS

nanofoot
materials, components and footwear with enhanced comfort properties

1. SPECIFICATIONS AND SCREENING OF NANOPARTICLES WITH POTENTIAL TO BE USED IN FOOTWEAR CONSUMER GOODS

- Screening commercially available NPs currently used in health, cosmetic and other industrial sectors.
- Characterization of NPs properties (morphology and antimicrobial activity).
- Evaluation of stability (temperature, light and pH).
- Selection of the most viable NPs to be tested for footwear materials.



(AVENEDA, INDINOR, CAMMINA, CTCP, UPORTO)

3.1 | NANOFOOT: LEATHER AND MICROFIBRES

nanofoot
materials, components and footwear with enhanced comfort properties

2. INVESTIGATION OF PROCESSING PRODUCTS AND COATINGS/FINISHING FORMULATIONS FOR PRODUCING TAILOR-MADE PRODUCTS

- Modification and optimization of nanoparticles to improve the stability and dispersion.
- Developing of chemical processing products and coatings for leather and microfibers with antimicrobial properties.
- Evaluation of stability (time, temperature, light).
- Selection of the most viable formulations.

IN MOST OF THE CASES, THE SUCCESSFUL APPLICATION OF NANOPARTICLES DEPENDS ON THE ABILITY TO PROPERLY DISPERSE THE NANOPARTICLES INTO A LIQUID MEDIUM AND AVOID AGGLOMERATION.

(AVENEDA, INDINOR, CAMMINA, CTCP, UPORTO)

3.1 | NANOFOOT: LEATHER AND MICROFIBRES

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materials, components and footwear with enhanced comfort properties

2. INVESTIGATION OF PROCESSING PRODUCTS AND COATINGS/FINISHING FORMULATIONS FOR PRODUCING TAILOR-MADE PRODUCTS

NANO-MODIFIED COATING FILM

ANTIBACTERIAL ACTIVITY

NON-MODIFIED COATING FILM

NANO-MODIFIED COATING FILM

ANTIBACTERIAL TEST BASED ON STANDARDS ISO 16187:2013 - FOOTWEAR AND FOOTWEAR COMPONENTS — TEST METHOD TO ASSESS ANTIBACTERIAL ACTIVITY.

(AVENEDA, INDINOR, CAMMINA, CTCP, UPORTO)

3.1 | NANOFOOT: LEATHER AND MICROFIBRES

nanofoot
materials, components and footwear with enhanced comfort properties

3. DEVELOPMENT OF LEATHERS AND MICROFIBERS BASED IN NANOPARTICLES

- Definition of technologies to functionalize the leather and microfiber surface materials: antibacterial and antifungal properties, breathability and water resistance and advanced footwear.
- Testing, evaluation and optimization of the chosen technologies and formulations by using model systems comprising defined matrices and chosen NP agents.

(AVENEDA, INDINOR, CAMMINA, CTCP, UPORTO)

3.1 | NANOFOOT: LEATHER AND MICROFIBRES

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materials, components and footwear
with enhanced comfort properties

3. DEVELOPMENT OF LEATHERS AND MICROFIBERS BASED IN NANOPARTICLES

(AVENEDA, INDINOR, CAMMINA, CTCP, UPORTO)

3.1 | NANOFOOT: LEATHER AND MICROFIBRES

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materials, components and footwear
with enhanced comfort properties

3. DEVELOPMENT OF LEATHERS AND MICROFIBERS BASED IN NANOPARTICLES

XRF EQUIPMENT

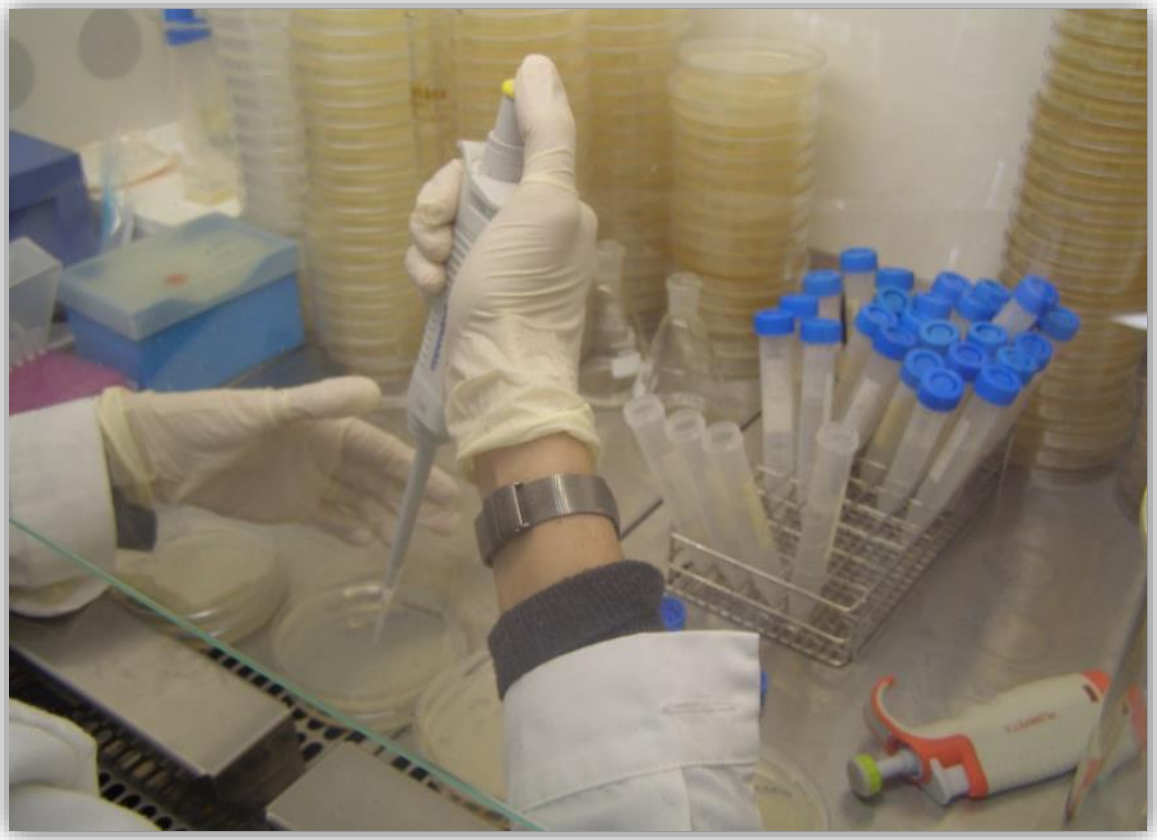
THE RESULTS INDICATE THAT THE DISPERSION OF NANOPARTICLES ON THE MATERIALS SURFACE IS RELATIVELY GOOD.

(AVENEDA, INDINOR, CAMMINA, CTCP, UPORTO)

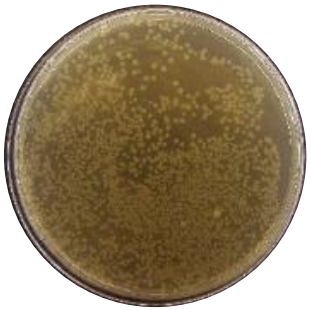
3.1 | NANOFOOT: LEATHER AND MICROFIBRES

nanofoot
materials, components and footwear with enhanced comfort properties

3. DEVELOPMENT OF LEATHERS AND MICROFIBERS BASED IN NANOPARTICLES



ANTIBACTERIAL ACTIVITY



NON-MODIFIED MICROFIBER

NANO-MODIFIED MICROFIBER

ANTIBACTERIAL TEST BASED ON STANDARDS ISO 16187:2013 - FOOTWEAR AND FOOTWEAR COMPONENTS — TEST METHOD TO ASSESS ANTIBACTERIAL ACTIVITY

(AVENEDA, INDINOR, CAMMINA, CTCP, UPORTO)

3.1 | NANOFOOT: LEATHER AND MICROFIBRES

nanofoot
materials, components and footwear with enhanced comfort properties

3. DEVELOPMENT OF LEATHERS AND MICROFIBERS BASED IN NANOPARTICLES

OTHER PROPERTIES

- MECHANICAL RESISTANCE PROPERTIES
- WATER VAPOUR PERMEABILITY
- ODOUR EVALUATION
- THERMAL COMFORT

(AVENEDA, INDINOR, CAMMINA, CTCP, UPORTO)

3.2 | NANOFOOT: EVA NANOCOMPOSITES

nanofoot
materials, components and footwear with enhanced comfort properties

1. MANUFACTURE OF NANOCOMPOSITE SHEETS

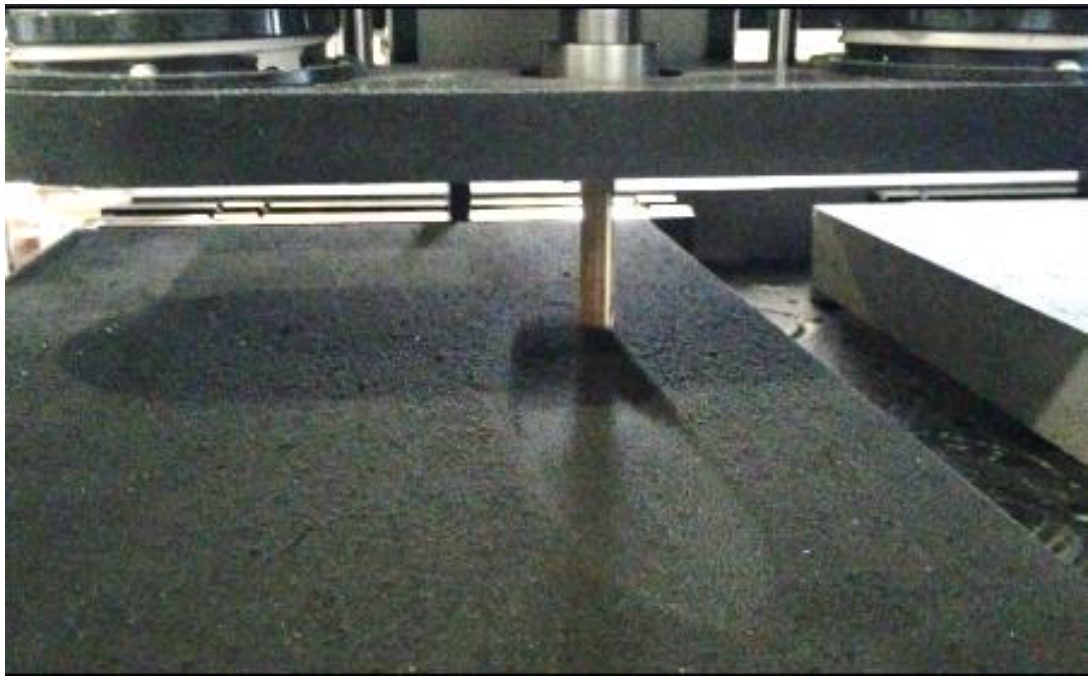
NO SUBSTANTIAL DIFFERENCES HAVE BEEN FOUND DURING NANOCOMPOSITE FORMULATION AND PROCESSING, WHEN COMPARED WITH CONVENTIONAL EVAS.

(EVATHINK, TPSP, INESCOP)

3.2 | NANOFOOT: EVA NANOCOMPOSITES

nanofoot
materials, components and footwear with enhanced comfort properties

2. MANUFACTURE OF ORTHOPAEDIC INSOLES BY MILLING



NO SUBSTANTIAL DIFFERENCES HAVE BEEN FOUND DURING INSOLE MACHINING, WHEN COMPARED WITH CONVENTIONAL EVA SHEETS.

(EVATHINK, TPSP, INESCOP)

3.3 | NANOFOOT: NANO TECHNOLOGICAL FOOTWEAR

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materials, components and footwear
with enhanced comfort properties

LEATHER ORTHOPAEDIC AND MICROFIBER VEGAN SHOES

(TPSP, CAMMINA, CTCP, INESCOP, CNR-ITIA)

3.4 | NANOFOOT: HUMAN SAFETY & ENVIRONMENTAL IMPACT

nanofoot
materials, components and footwear with enhanced comfort properties

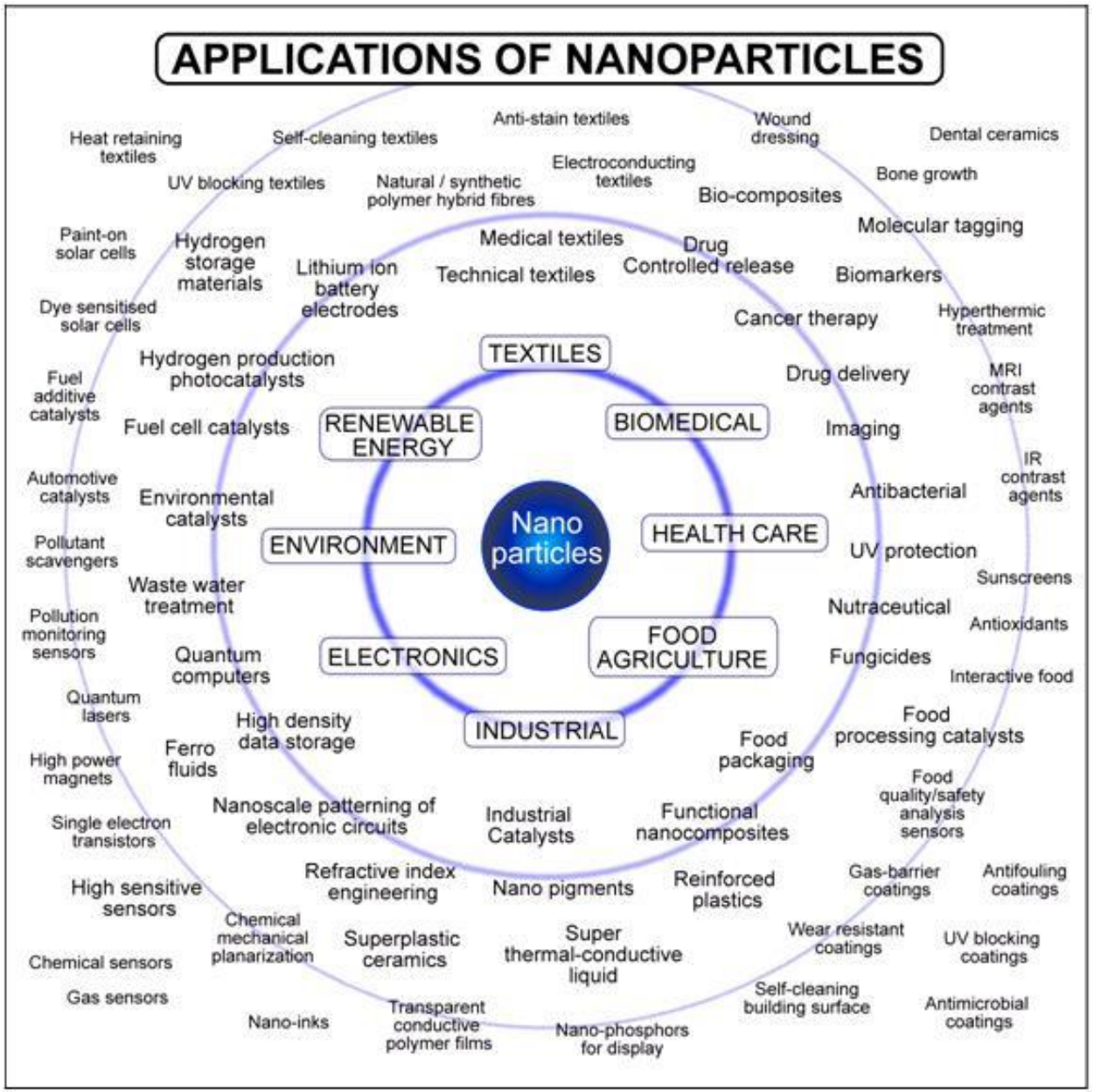


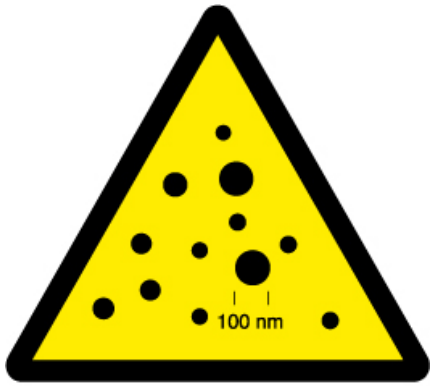
Image Source: http://www.thesleuthjournal.com/nanoparticles-the-tiniest-toxin/

3.4 | NANOFOOT: HUMAN SAFETY & ENVIRONMENTAL IMPACT

nanofoot
materials, components and footwear with enhanced comfort properties

RISKS ASSOCIATED TO USE OF NPS

- RELATIVELY CHEAP AND CAN BE MANUFACTURED IN LARGE QUANTITIES
- ALREADY USED IN CONSUMER PRODUCTS
- PROPERTIES CAN BE VERY DIFFERENT TO THE LARGER FORMS OF THE MATERIAL THEY ARE MADE FROM
- CAN BE HIGHLY REACTIVE
- OFTEN HAVE UNKNOWN TOXICITY
- TOXICITY CAN BE DIFFICULT TO QUANTIFY
- CAN DISPERSE EASILY IN AIR OR WATER



Source: RISKS, LLOYD's Emerging Risks Team Report, Nanotechnology Recent Developments, Risks and Opportunities (2007)

3.3 | NANOFOOT: HUMAN SAFETY & ENVIRONMENTAL IMPACT

nanofoot
materials, components and footwear with enhanced comfort properties

POTENTIAL RISK OF USING NPS IN CONSUMERS PRODUCTS

INHALATION
ABSORPTION THROUGH SKIN
INGESTION BY DRINK, FOOD

ACCUMULATION IN WATER, SOIL, AIR

NPS CAN AGGLOMERATE OR AGGREGATE ORIGINATING LARGER PARTICLES, REDUCING ANY PROPERTY THAT IS RELATED WITH ITS SIZE OR CHEMICAL REACTIVITY.

3.4 | NANOFOOT: HUMAN SAFETY & ENVIRONMENTAL IMPACT

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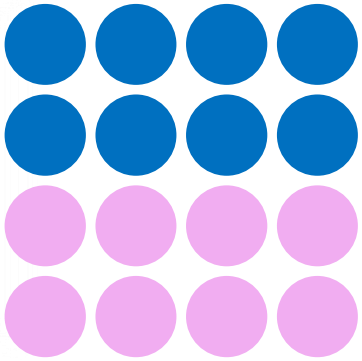
materials, components and footwear with enhanced comfort properties

1. HUMAN SAFETY TESTS

- Evaluation of solvent effect on NPs toxicity.
- Evaluation of NMs toxicity to human cell lines: Caco-2, HepG2, SV-80 and HaCaT.



(UPORTO)

3.4 | NANOFOOT: HUMAN SAFETY & ENVIRONMENTAL IMPACT

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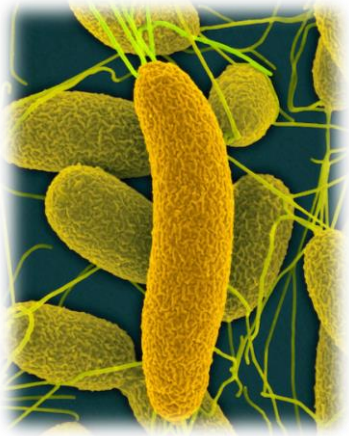
2. ENVIRONMENTAL IMPACT TESTS

- Identification of potential hazard of single nanoparticle.
- Vibrio fischeri NRRL B-11177 bacteria toxic effects.
- Microalgae P. supcapitata toxic effects.
- Microalgae D. magna acute toxic effects.
- "Standard" soil arthropod F. candida toxic.



(UPORTO)

3.4 | NANOFOOT: HUMAN SAFETY & ENVIRONMENTAL IMPACT

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3. NPS RELEASE FROM MATERIALS TESTS

- Mobilization of NPs to acid and alkaline synthetic sweat for direct contact to material samples.
- Mobilization of NPs to acid and alkaline synthetic sweat and transference of NPs to multifiber material by contact.
- Removal of NPs from the materials surface by friction.
- Footwear Wear trials.

3.4 | NANOFOOT: HUMAN SAFETY & ENVIRONMENTAL IMPACT

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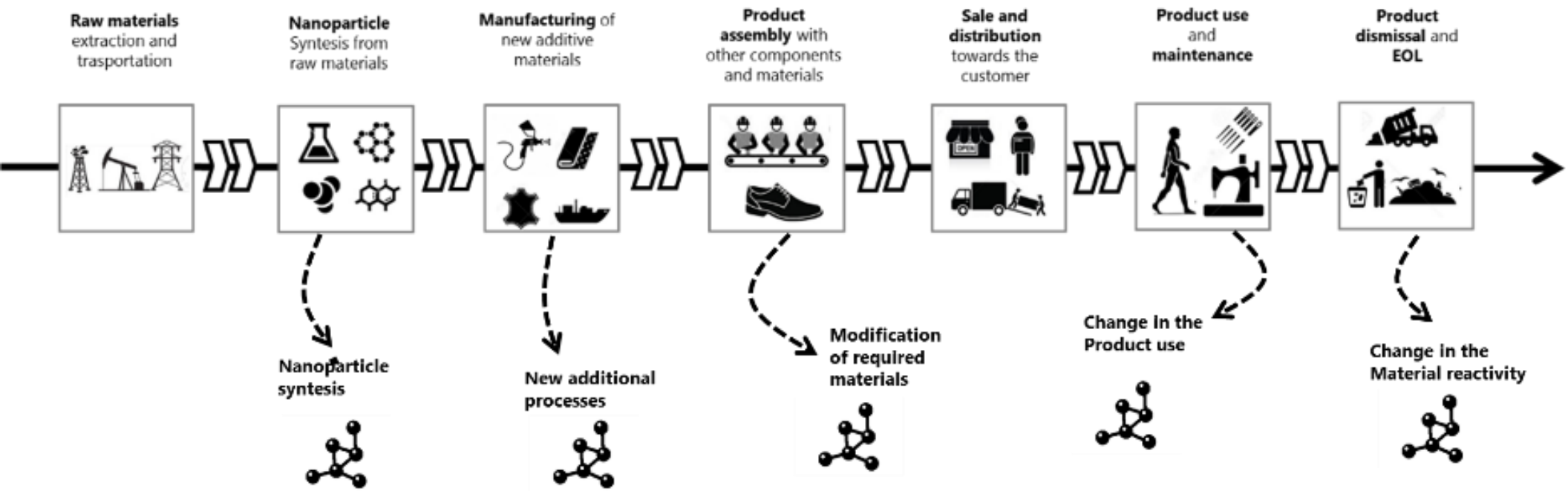
4. LIFE-CYCLE PERSPECTIVE



THE LIFE CYCLE-PERSPECTIVE OF A NANOMATERIAL REQUIRES TO FULLY IMPLEMENT THE MONITORING OF CONSUMPTION AND EMISSION DURING THE WHOLE LIFE CYCLE OF A SPECIFIC SYSTEM.

(CNR - ITIA)

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THANK YOU NANOFOOT PARTNERS FOR THE EXCELLENT COLLABORATION!

THANK FOR YOUR ATTENTION!

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Maria José Ferreira, mjose.ferreira@ctcp.pt

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