NANO – what is it?

Nanomaterials – any material of any shape with at least one dimension smaller than 100nm

VARIOUS NANOMATERIALS – defined by shape

NANOPARTICLES

NANOTUBES

NANORODS

NANODOTS

NANOCRYSTALS

NANOFIBERS
PARDAM – what do we do??

NANOFIBERS MADE BY PARDAM

ELECTROSPINNING
CENTRIFUGAL SPINNING
R&D only
SOLUTION SPINNING
MELT SPINNING

PRODUCTION
DEVELOPMENT
OTHER SERVICES

CUSTOM MADE - INORGANIC NANOFIBERS
CUSTOM MADE - POLYMERIC NANOFIBERS

CONTRACTUAL PRODUCTION
PRODUCTS & APPLICATIONS
TECHNOLOGY

XRD
SEM
BET
RESEARCH STUDIES
Inorganic nanofibers
(powder like materials)

Inorganic nanofibers are special function materials in the form of thin fibers, which possess very high accessibility of its surface enhanced many times by the inner porosity of fiber material. Its benefit in batteries, catalyst, abrasives or composite material is ultra-high surface accessible for gas, liquid or solid material.

The benefit over nanoparticles is that nanoparticles are not porous, they have different morphology so they can settle down and do not allow the medium to contact with the surface and they are very difficult to fix in defined place.

- Li-ion batteries anode or cathode,
- Li-ion battery/Fuel cell separator,
- Catalyst, Catalyst support,
- Photo catalyst, Gas sensors,
- Thermal insulators,
- Metal or Ceramics nano-composites,
- Dehumidifiers,
- Abrasives,
- Thermal barrier coatings,
- Filtration etc.

PRODUCTION CAPACITY: 500-1000 kg annually
Polymer nanofibers

- PUR, PA6, PVB, PVA
- Paraloid
- PET
- Composite PA6/PU modification – doping with nanoparticles
- PAN, PVDF, PCL, doping with liquids
- Surface treatment
- 3D structure formation
- Plasma treatment

Filtration

- Air, water, wastewater, other liquids and gases
- Submicron fiber thickness allows much thinner pores of filter with ultra high flux of filtered media
- The ultra-high fiber surface allows to capture very small particles as well as bacteria. The structure of nonwoven polymer nanofiber layer is very breathable resulting of very high permeability of membrane.

Function textiles

- Main effect is the non-liquid permeability consequently with very high breathability for air and vapor.

Medicine

- The main issue for wound dressing and tissue scaffold is the softness of nanofibers with the combination of breathability and bacteria barrier.

PRODUCTION CAPACITY:

- thousands of m² annually
Centrifugal forces spinning technology

POLYMER SOLUTION

SPINNING - HEAD
- NOOZLES

LABORATORY EQUIPMENT

PILOT LINE
KNOW-HOW ON UPSCALING

PRODUCTION LINES
SERVICES - Production

CENTRIFUGAL SPINNING CANDY PRODUCTION LINE new2015

NnF CERAM®
Industrial production of inorganic nanofibers – powders and cotton like structures
TiO$_2$, SiO$_2$, ZrO$_2$, CeZrO$_2$, WO$_3$, LTO, BTO, SBTO, Al$_2$O$_3$,

CENTRIFUGAL SPINNING SOLUTION LINE 1.1m width
CENTRIFUGAL SPINNING MELT LINE 0.5m width new2015

NnF MBRANE®
Industrial production of Polymer nanofibers - membranes
PA6, PUR, PVB, PCL, PAN, PVDF, PVA, special polymers…
We are partners in 7FP program
| MATFLEXEND – developing nanofibrous materials for ANODE of Li-Ion batteries and piezoelectric cells
Partners: Fraunhofer Berlin, VARTA, …

Czech government R&D project - ALFA
| SiO2 nanofibrous sorbent

Private projects
| HE3DA
| SOLVAY

Developing new application
| Li-ion battery separators
| Water purification filters
| Biomedical products

SERVICES – R&D materials / applications / products
WE CAN BE YOUR PARTNER IN YOUR PROJECT - (HORIZON2020, ....)
SURE WE CAN MAKE IT!!

NANOFIBROUS APPLICATIONS AND PRODUCTS DEVELOPED BY PARDAM

4 PATENT PENDING APPLICATIONS

• 2014 - Inorganic nanofibers for catalytic reactions
• 2015 – Inorganic nanofiber for peptide analyses
• 2015 – Electrically conductive nanofibrous membrane
• 2015 – SiO2 nanofibrous sorbent

4 COMMERCIAL PRODUCTS in 2015

• NnF MBRANE - PET nanofibrous sandwich membrane for swimming pool water purification
• NnF MBRANE – PA6 nanofibrous sandwich membrane for food products purification
• NnF CERAM - SiO2 based ceramic Li-Ion battery separator
• NnF CERAM - ZrO2 based analytical tips for peptide analyses
New flexible, durable and solution-processable ink materials for energy harvesting integrating mechanical-to-electrical energy conversion and storage in single device

FP7 project co-funded by EC

- LTO nanofibers
- TiN nanofibers
- LTO nanofibers - modified with TiN surface (conductive)
- BTO and SBTO nanofibers
- Hybrid polymer nanofibers PVDF/PUR/PA6 with BTO nanofibers incorporated
- Dielectric PVDF nanofibrous membranes

- Material analyses SEM/BET/XRD/XPS
“We make nanofibers”

Development of SiO2 nanofibers with high surface area for sorbents

- Developing new solutions based on TEOS precursor
- Optimizing Centrifugal spinning technology for mass production
- Optimizing calcination curves in order to get high surface (up to 1000m²/g)
- Patent application  PS4039CZ
NnF CERAM for CERAMIC SEPARATOR FOR 3D LI-ION BATTERY

Unique and patented solution of the ceramic separator for 3D Li-Ion battery

Partner: HE3DA

SAFETY - stable up to 500° C

WETTABILITY
Better saturation with electrolyte improves ionic conductivity between electrodes

ROBUST CONSTRUCTION
Ceramic separators do not allow dendrites growing and prevent shortage creation inside accumulators

STABILITY – ceramic separators keep its structure and shape

CONSTANT DIMENSIONS
Thanks to nanofibrous materials – specific surface of the separators is in hundreds of m²/g hence constant dimensions of the material in the volume of the separator is reached

LOWER FARADAY LOSSESS
Nanofibrous structure enables faster diffusion of Lithium Ions through separator which decreases faraday loses in the accumulator

3 Working prototype 1kW Li-ion battery was launched in March 2015!
NnF CERAM for SELECTIVE AND EFFICIENT ENRICHMENT OF PHOSPHOPEPTIDES

Columns packed with nanofibers show significantly higher permeability in comparison to the particle packed column.

Efficient enrichment of single and multiphosphorylated peptides from tryptic digests achieved.

Fabrication of new types of nanofibers such as SnO$_2$, Ga$_2$O$_3$ and HfO$_2$ in progress.

Further evaluation of the nanofibers materials by “real” proteomic samples needed - collaborators welcomed.

Partner: **Institute of Analytical Chemistry, Brno, Czech Republic**
NnF MBRANE for SWIMMING POOL WATER PURIFICATION

Novel cartridge Swimming pool Water purification system

Partner: SACOPA

SIZE: 3 times smaller comparing to sand filters
WEIGHT: 5 times lighter comparing to sand filters

HIGHER FILTRATION EFFICIENCY!!

LOWER PRESSURE DROP = smaller pumps
HIGHER FLOW RATE = faster filtration

CLEANING SHOWER INCORPORATED = comfortable cleaning

PARDAM: manufactures PET nanofibrous membrane

Development took 5 months!
“We make nanofibers”

NnF MBRANE for face masks / decontamination sorbent membranes
Thank you for your attention

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