

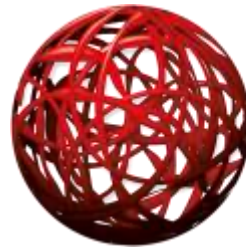


Permanent Representation  
of the Czech Republic  
to the European Union



**nano asociace**

ASOCIACE NANOTECHNOLOGICKÉHO PRŮMYSLU ČR



**Pardam**  
nanotechnology



**CZELO**



**CZECH IS NANO**

BRUSELESS OCTOBER 15<sup>th</sup> 2015

Jan Buk  
COO Pardam s.r.o.

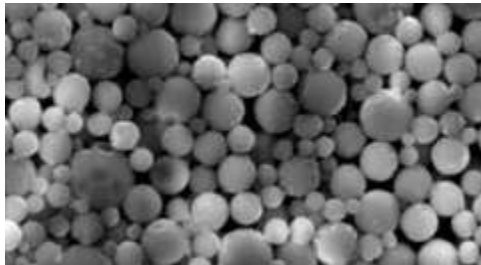
*"We make nanofibers"*

## NANO – what is it?

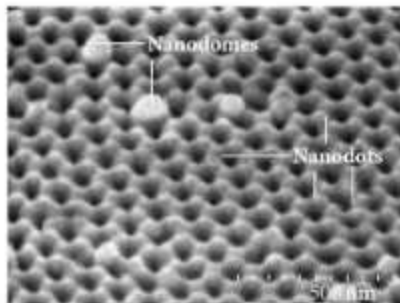
Nanomaterials – any material of any shape with at least one dimension smaller than 100nm

VARIOUS NANOMATERIALS – defined by shape

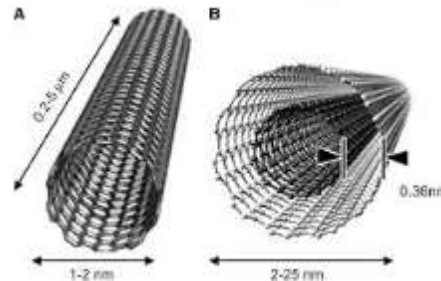
### NANOPARTICLES



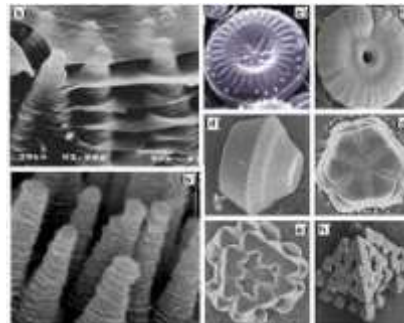
### NANODOTS



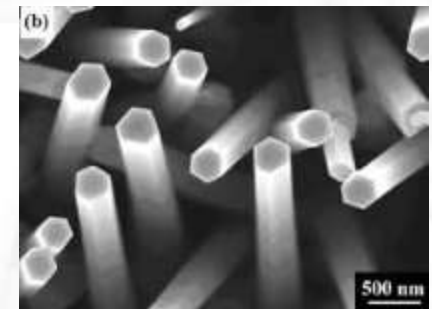
### NANOTUBES



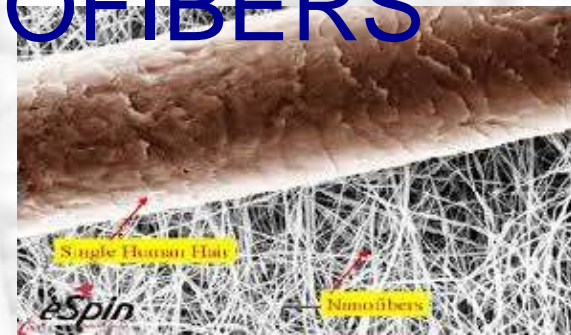
### NANOCRYSTALS



### NANORODS



## NANOFIBERS



*"We make nanofibers"*



## PARDAM – what do we do??

**NANOFIBERS  
MADE BY  
PARDAM**

**ELECTROSPINNING**

R&D only

**CENTRIFUGAL SPINNING**

**SOLUTION  
SPINNING**

**MELT  
SPINNING**

**PRODUCTION**

**DEVELOPMENT**

**OTHER SERVICES**

**CUSTOM MADE - INORGANIC NANOFIBERS**

**CUSTOM MADE - POLYMERIC NANOFIBERS**

**XRD**

**SEM**

**BET**

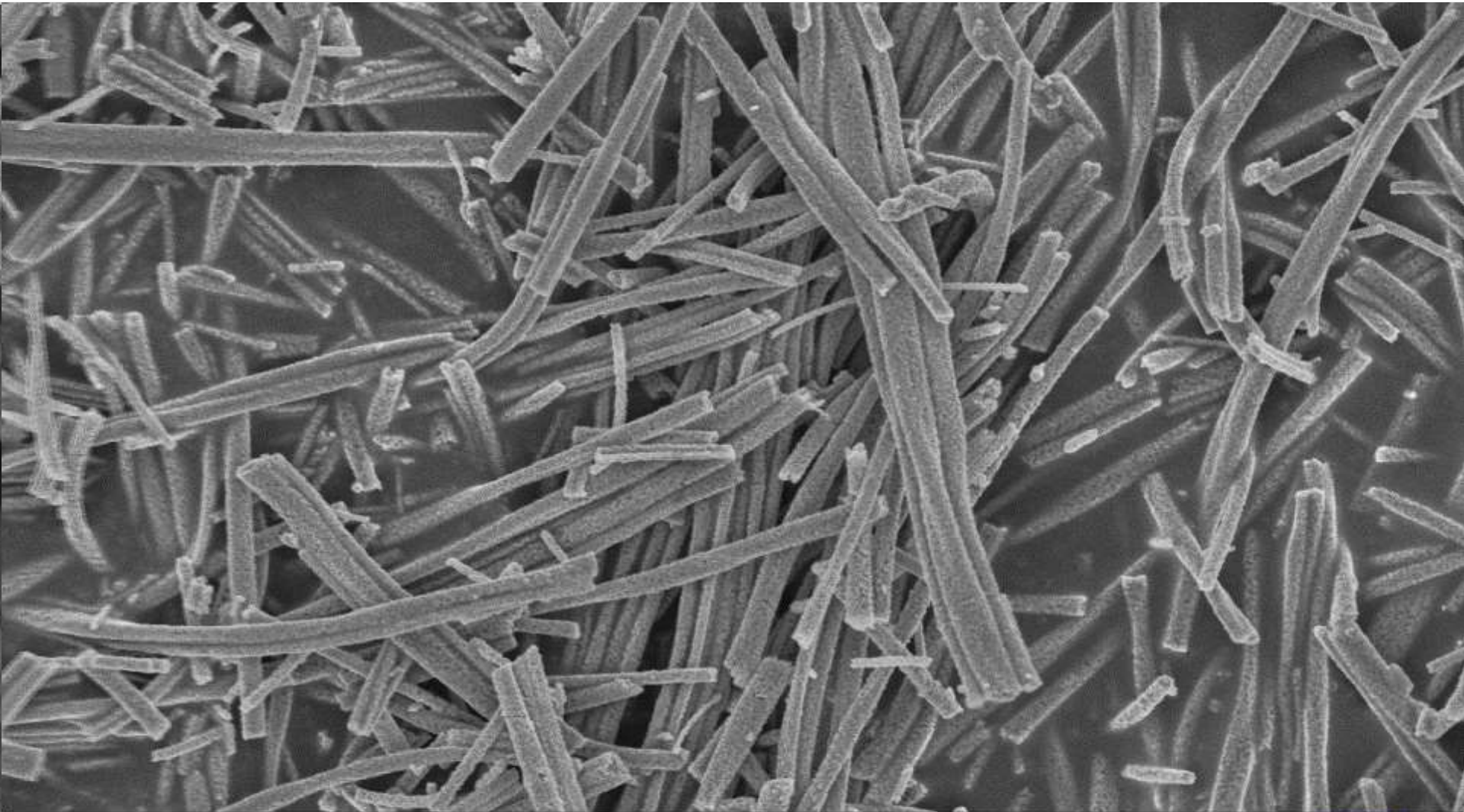
**CONTRACTUAL  
PRODUCTION**

**PRODUCTS &  
APPLICATIONS**

**TECHNOLOGY**

**RESEARCH STUDIES**

*"We make nanofibers"*



1  $\mu\text{m}$

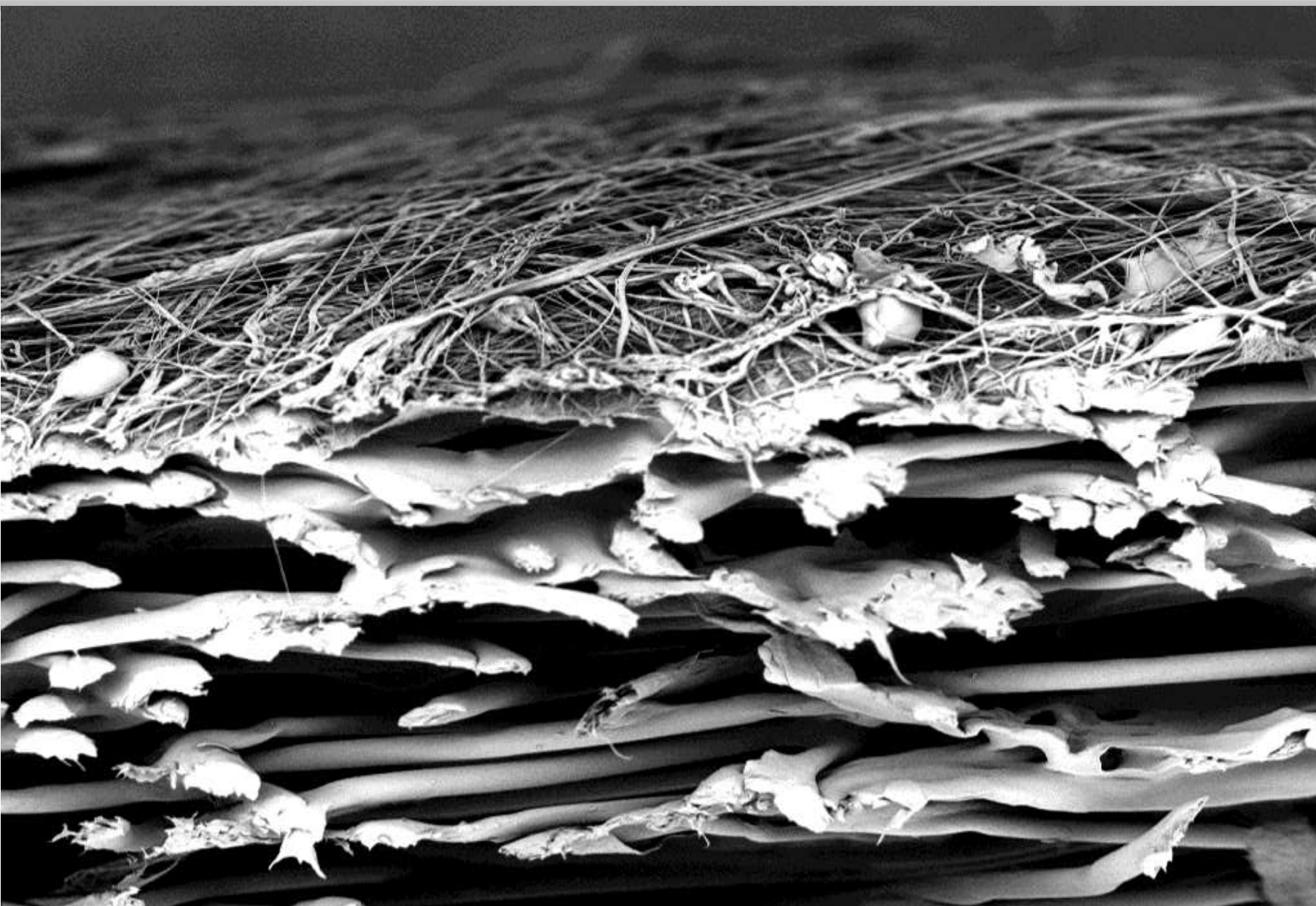


EHT = 5.00 kV  
WD = 10.9 mm

Signal A = InLens  
Mag = 10.00 K X

Date :15 Apr 2014  
Time :18:37:46

*"We make nanofibers"*

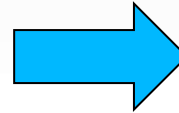


500x  
535 μm  
260 μm  
MAY 22 2013 13:59  
prurez

*"We make nanofibers"*

# Centrifugal forces spinning technology

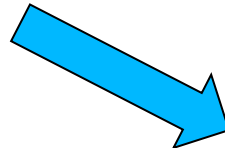
POLYMER SOLUTION



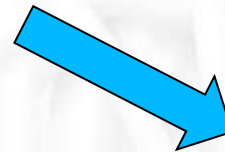
SPINNING - HEAD  
- NOOZLES



LABORATORY EQUIPMENT



PILOT LINE  
KNOW-HOW ON UPSCALING



PRODUCTION LINES



*"We make nanofibers"*

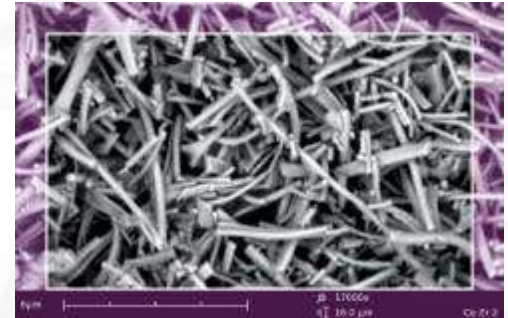
## SERVICES - Production

CENTRIFUGAL SPINNING CANDY PRODUCTION LINE new2015

### **NnF CERAM**<sup>®</sup>

Industrial production of inorganic nanofibers – powders and cotton like structures

TiO<sub>2</sub>, SiO<sub>2</sub>, ZrO<sub>2</sub>, CeZrO<sub>2</sub>, WO<sub>3</sub>, LTO,  
BTO, SBTO, Al<sub>2</sub>O<sub>3</sub>,



CENTRIFUGAL SPINNING SOLUTION LINE 1.1m width

CENTRIFUGAL SPINNING MELT LINE 0.5m width new2015

### **NnF MBRANE**<sup>®</sup>

Industrial production of Polymer nanofibers  
- membranes

PA6, PUR, PVB, PCL, PAN, PVDF,  
PVA, special polymers...



*"We make nanofibers"*

# SERVICES – R&D materials / applications / products

WE CAN BE YOUR PARTNER IN YOUR PROJECT - (HORIZON2020, ....)

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  
| SiO<sub>2</sub> nanofibrous sorbent

Private projects  
| HE3DA  
| SOLVAY

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





*"We make nanofibers"*



## 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 – SiO<sub>2</sub> 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 - SiO<sub>2</sub>** based ceramic Li-Ion battery separator
- **NnF CERAM - ZrO<sub>2</sub>** based analytical tips for peptide analyses



*"We make nanofibers"*



★ 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

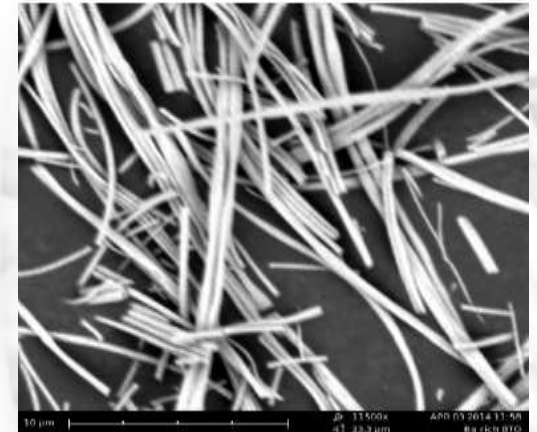
| LTO nanofibers - modified with TiN surface (conductive)

| BTO and SBTO nanofibers

| Hybrid polymer nanofibers PVDF/PUR/PA6 with BTO nanofibers incorporated

| Dielectric PVDF nanofibrous membranes

| Material analyses SEM/BET/XRD/XPS



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Development of SiO<sub>2</sub> 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 1000m<sup>2</sup>/g)
- | Patent application PS4039CZ



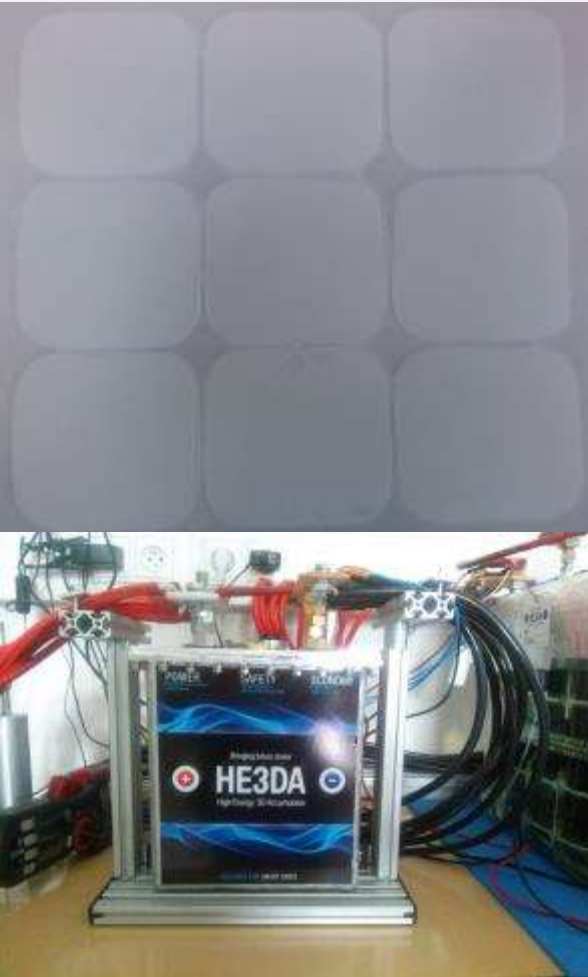
University  
of Pardubice

Program **Alfa**

*"We make nanofibers"*



## **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 m<sup>2</sup>/g hence constant dimensions of the material in the volume of the separator is reached

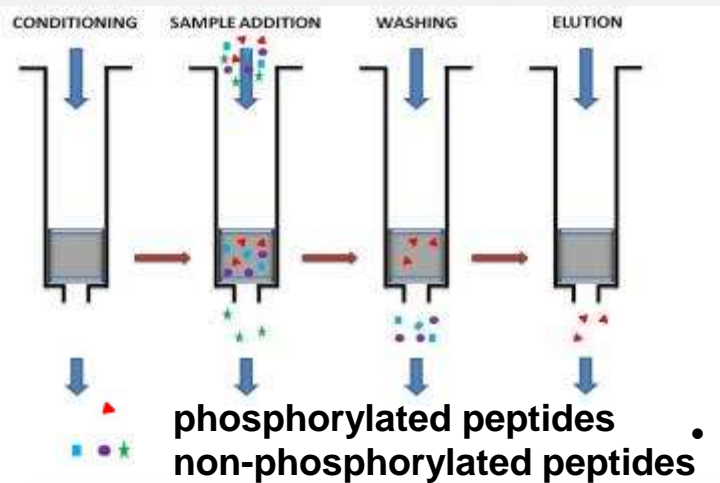
**LOWER FARADAY LOSESS**

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!**

"We make nanofibers"

## NnF CERAM for SELECTIVE AND EFFICIENT ENRICHMENT OF PHOSPHOPEPTIDES



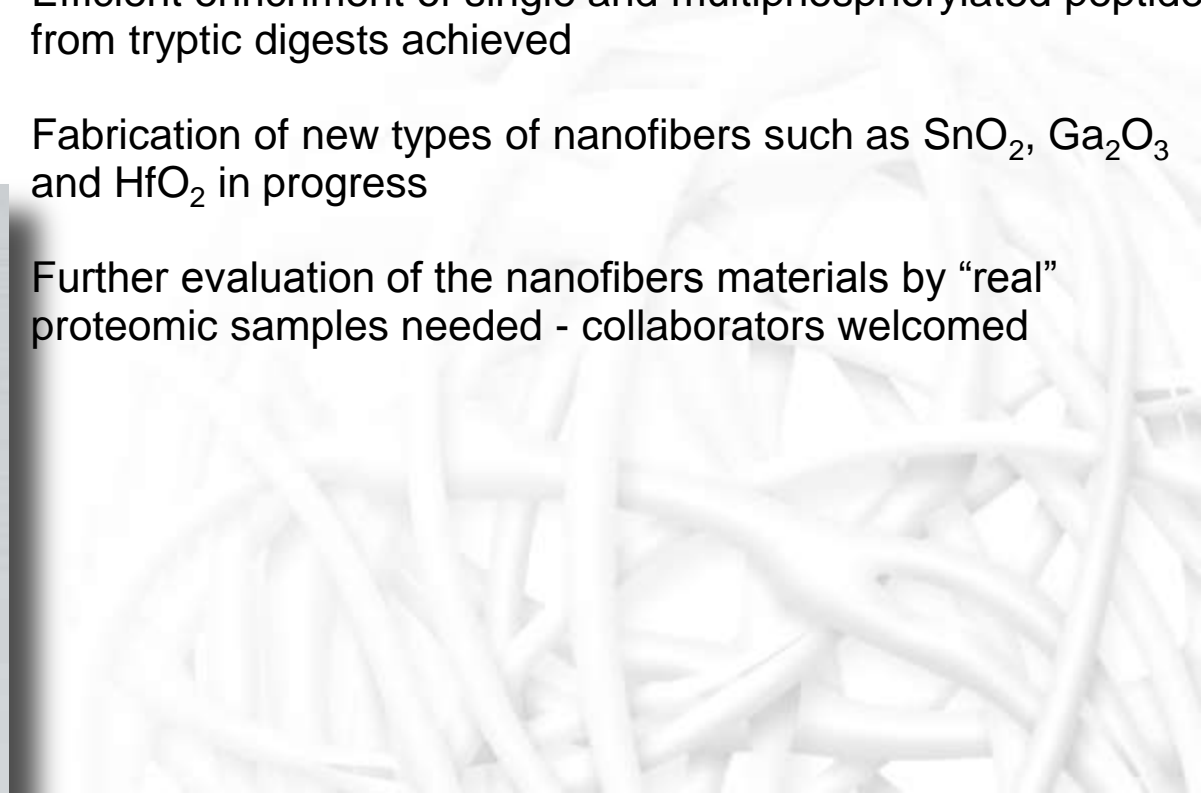
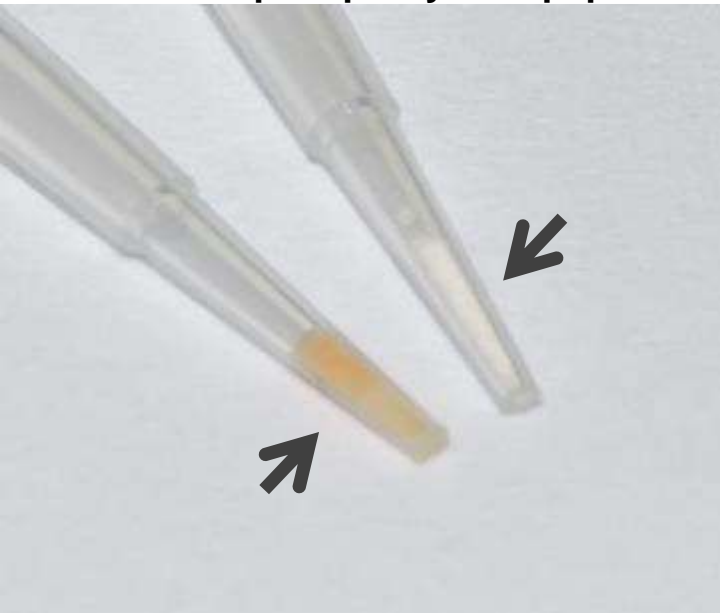
Partner: **Institute of Analytical Chemistry, Brno, Czech Republic**

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

Efficient enrichment of single and multiphosphorylated peptide from tryptic digests achieved

- Fabrication of new types of nanofibers such as  $\text{SnO}_2$ ,  $\text{Ga}_2\text{O}_3$  and  $\text{HfO}_2$  in progress

Further evaluation of the nanofibers materials by "real" proteomic samples needed - collaborators welcomed



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## **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

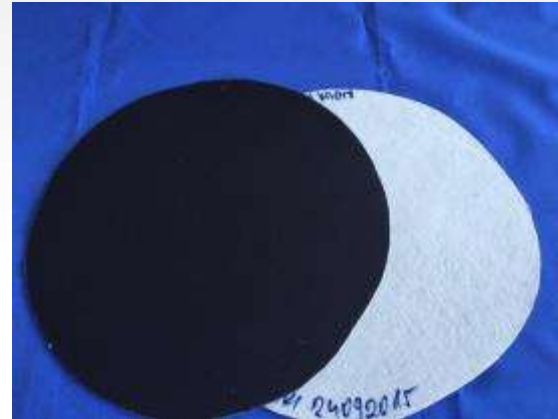
**PARDAM** : manufactures PET nanofibrous membrane

Development took 5 months!



*"We make nanofibers"*

**NnF MBRANE** for face masks / decontamination sorbent membranes



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Thank you for your attention

[www.pardam.cz](http://www.pardam.cz)

[jan.buk@pardam.cz](mailto:jan.buk@pardam.cz)

