Pre-commercial lines for production of surface nanostructured antimicrobial and anti-biofilm textiles, medical devices and water treatment membranes
THE GLOBAL CHALLENGE for protect

- Health care associated infections
- Antibiotic resistant bacteria
- Microbial biofilms
- Unsafe water

- High incidence of hospital-acquired infections.
- 3,000,000 people/year infected in the EU
- 50,000 people die
- €7 billion/year financial loss

- 80% of all infections treated in hospitals are due to biofilms on indwelling medical devices

- Antibiotics overuse
- Multidrug-resistant bacteria in the EU cause €1.5 billion/year financial loss

- Waterborne diseases - among the major causes of preventable morbidity and mortality
CUSTOMERS
manufacturers of antimicrobial and anti-biofilm textiles, medical devices, and water treatment membranes

PROBLEM
The customers do not dispose with efficient technologies to manufacture these products with high-quality and durability

EXISTING ALTERNATIVES
High energy consuming and inefficient coating processes, resulting in low durability of the antimicrobial and anti-biofilm effect.
Cost effective, sustainable and reliable nano-coating production lines that enable customers to create high-quality anti-biofilm, antimicrobial and biocompatible nano-coated products with longer lifetime than competing products at a fraction of the price.
• Patent-protected technologies
• Versatile coating processes employing ultrasound adaptable for any active agent, coated material and product shape.
• A single step nano-functionalisation with novel efficient nano-antimicrobials
• In-situ synthesis and coating with nano-antimicrobials
• Integrated real-time monitoring tools for nanotechnology-based processes and products.
• Ease of integration of the new technologies in existing manufacturing facilities.
• Low manufacturing costs
The study includes 37 patients with burns and different soft tissues. Whether the elimination of ethanol as the solvent in the hydrolysis, 2.5% of the initial amount of the corresponding metal acetate was dissolved in 100 mL and added every 10 min to the hydrolysis, 2.5% of the initial amount of the precursor was added to the reaction solution. The pH of the solution changed to around 10 nm.

Hybrid NPs: ZnO/tannic acid/enzyme

Inorganic NPs: ZnO, CuO, Zn-CuO, MgF₂

The XRD patterns of the sonochemically prepared ZnO NPs crystallized in a base-centered monoclinic tenorite phase (PDF: 01-089-1397). The crystallite size estimated by the Debye–Scherrer equation is about 19 nm. No characteristic peaks respond to hexagonal phase of zincite (PDF: 01-089-0252). The peaks at 2θ = 35.56, 38.74, and 48.74 are assigned to 2529. The peaks at 2θ = 31.772, 34.420, 36.256, 56.602, and 62.858, are assigned to 86 85 84 83 82.

The antibacterial properties of the ZnO and CuO coating process, the coated amount was probed over 50 m of fabric. Every 10 min. The speed of the rolling of fabric during the coating process was 0.5 m/min. In order to evaluate the quality of the continuous coating process, the coated amount was probed over 50 m of fabric.

The following parameters were observed and analyzed over 18–24 h at 35–37°C. For the hospital experiments large quantities of ZnO-coated cotton pillow covers, and were dressed with antibacterial pyjamas. Where 21 patients slept on antibacterial bed sheets, used antibacterial patients' gowns, and 15 patients were dressed in regular patients' gowns. Over 18–24 h, the cultures were inspected for microbial growth. The isolation strains were done using Steward’s transport medium. Cultures were prepared using standard biochemic, microbiologic and the viable bacteria were counted.

Lower level of bacterial infection in “antibacterial” patients than the “regular” ones. (Clinical study with 37 patients)
MARKETS

Total Addressable Market – manufacturers of functional materials used in textile and clothing industries, transportation, construction, healthcare, food packaging and water treatment.

Serviced Available Market – manufacturers of antimicrobial and anti-biofilm textiles, medical devices and water filters *produced by conventional technologies*

Target Market – manufacturers of antimicrobial and anti-biofilm hospital textiles, catheters and water treatment membranes
THE MARKET OF HOSPITAL BED LINEN

- About 2,000,000 hospital beds available in EU for acute diseases with an occupation rate of 75% and an average of 4 days hospitalisation.
- Need for about 3 millions sets of hospital bed sheets
- €15 millions/year market value for new bed sheets
- €3-4 billions/year bed sheets maintenance market
- 47 suppliers of hospital sheets in EU
A. The antimicrobial treatment as a service
Manufacturer of bed sheet buying the antibacterial treatment (service) from a partner with pilot unit through inter-partners agreements for exploitation

<table>
<thead>
<tr>
<th>Time period of forecast</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>forecast sales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bed sheets (*) Quantities</td>
<td>4.168,02</td>
<td>10.420,04</td>
<td>20.840,09</td>
<td>31.260,13</td>
<td>37.512,16</td>
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<tr>
<td>Revenues (€) **</td>
<td>166.721</td>
<td>416.802</td>
<td>833.604</td>
<td>1.250.405</td>
<td>1.500.486</td>
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<tr>
<td>prototype unit</td>
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<td></td>
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<td></td>
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<tr>
<td>unit cost of finishing (****)</td>
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<td>3,71</td>
<td>3,55</td>
<td>2,69</td>
<td>2,49</td>
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<tr>
<td>Total Manufacturing Direct Costs (€)</td>
<td>11.757</td>
<td>29.393</td>
<td>58.786</td>
<td>88.179</td>
<td>105.815</td>
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<tr>
<td>Cost for finishing (€)</td>
<td>16.127</td>
<td>38.639</td>
<td>73.917</td>
<td>84.243</td>
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<tr>
<td>Total Direct Costs (€)</td>
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<td>68.032</td>
<td>132.703</td>
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<td>Total Indirect costs(€)</td>
<td>5000</td>
<td>7.500</td>
<td>10000</td>
<td>12.500</td>
<td>15000</td>
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<tr>
<td>Gross Profit (€)</td>
<td>133.836</td>
<td>341.270</td>
<td>690.900</td>
<td>1.065.484</td>
<td>1.286.162</td>
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<tr>
<td>Investment in Fixed Assets (manufacturing) (€) ***</td>
<td>15.000</td>
<td>15.000</td>
<td>15.000</td>
<td>15.000</td>
<td>15.000</td>
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<tr>
<td>Net profit</td>
<td>118.836</td>
<td>326.270</td>
<td>675.900</td>
<td>1.050.484</td>
<td>1.271.162</td>
</tr>
</tbody>
</table>

(*) high quality bed sheets with special design and colours, suitable for clinics and also for wellness centers

(****) functionalisation is carried out by US R2R pilot by minimal charge according to project partner internal agreements for exploitation
B. Internalisation, verticalisation and total control of the value chain by one entity purchasing a pilot

Manufacturer with pilot unit producing and selling bed sheets

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<td>1.500.486</td>
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<tr>
<td>prototype unit</td>
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<td>1,92</td>
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<tr>
<td>unit cost of finishing</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total Manufacturing Direct Costs (€)</td>
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<td>29.393</td>
<td>58.786</td>
<td>88.179</td>
<td>105.815</td>
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<td>Cost for finishing (€)</td>
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<tr>
<td>Total Indirect costs(€)</td>
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<td>7.500</td>
<td>10000</td>
<td>12.500</td>
<td>15000</td>
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<tr>
<td>Gross Profit (€)</td>
<td>110.738</td>
<td>333.446</td>
<td>709.460</td>
<td>1.083.890</td>
<td>1.307.547</td>
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<tr>
<td>Investment in Fixed Assets (manufacturing) (€)**</td>
<td>40.000</td>
<td>40.000</td>
<td>40.000</td>
<td>40.000</td>
<td>40.000</td>
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<tr>
<td>Net profit</td>
<td>70.738</td>
<td>293.446</td>
<td>669.460</td>
<td>1.043.890</td>
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</tr>
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(**) Price per unit 40€

(***) Investments for internalisation of the process by acquiring a functionalisation unit with estimated value of 200k€
• 8% total market share in 5 years by addressing clinics, hospitals and wellness centres with high quality low-medium production volume.

• 30% market share in 5 years by large volumes production. Investments to acquire 8 pilots or to intensify the existing ones.

• Expand the business model to hotels and elderly care centres.
70% industry participation + highly innovative technology providers = commitment for success
STATE-OF-THE-ART AND FUTURE ACTIVITIES

Validated technologies:
• **Three nano-particle coating pilots** operating in real conditions

Future activities:
• **Scale-up of the pilots** to industrial production standards
• Integration in the pilots of **real time process and product monitoring tools**
CALL TO ACTION

Potential users of the nano-coating sonochemical technology are invited to test the coating lines for specific products.

The manufacturers will be assisted to evaluate both the technology and the functionality of the end products.

Different business scenarios will be suggested - acquisition of the nano-coating machines or their use as an external service.