



Contract No: NMP4-CT-2006-033256

Project acronym: BeNatural

Project title: Bioengineered Nanomaterials for Research and Applications

Instrument: STREP

Thematic Priority: NMP

Publishable Executive Summary

Period covered: from 1/09-2006 to 31/08-2007 **Date of preparation:** 2007-10-07

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Start date of project: 1/09-2006 **Duration:** 36 months

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Project website: <http://www.materials.uoc.gr/~BeNatural/>

Only for confidential use:

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Publishable executive summary

BeNatural targets to use nature as model for new nanotechnology-based processes by applying fundamental knowledge from structure and assembly of biological nanofibers and nanotubes into new innovative ways of designing and assembling man-made nanodevices. **The main objectives** are: (i) to develop new self-assembling nanowires and nanotubes from building blocks inspired from natural folding and assembly motifs of proteins, (ii) to use these nanowires and nanotubes as templates for the growth of inorganic/nano/materials, (iii) to develop techniques to manipulate, assemble and position these materials in a controlled manner, in view of their integration in future generations of nanoscale devices, and (iv) to use the self-assembling nanostructures in biosensing and tissue engineering applications. More precisely, the activities of the participants are focused on the following main activities:

- identification of structurally recurring elements in natural fibrous proteins
- rational design and synthesis of self-assembling proteins and peptides
- structural characterization and assessment of the self-assembled blocks
- formation of biological/non-biological interface through modification of the self-assembling peptides and proteins
- manipulation, positioning and assembly of the inorganic nanowires and nanotubes
- use of nanotubes/nanowires and nanostructured networks in biosensing and tissue regeneration applications, respectively

During the **first year of the project** all planned objectives were addressed as foreseen and deliverables have been delivered in time, well in accordance with the technical annex of the contract. In most activities (detailed in work packages), progress is beyond the planned ones; three were started earlier than planned and significant progress has already been made in most of them. The following main results were obtained :

- optimised expression, purification, and biochemical characterization protocols of recombinant fibrous proteins
- identification of the first generations of short peptide fragments (building blocks) that efficiently self-assemble into fibrous structures
- first assessment of nanoscale characterization and physicochemical properties of the building blocks
- fundamental diagnostic and structural information on the first generation of assembled structures
- initial results on nanomanipulation of the peptide nanotubes.
- Selection of electrode material, biochip architecture and protocol for creating MEA-based biosensors. Establishment of protocols for testing the self-assembled peptides in optic nerve regeneration.
- establishment of management bodies and follow-up strategy
- establishment of dissemination, communication, and exploitation strategies (CA)
- design and implementation of project website and design of BeNatural PR materials

After the first year of the project, the Consortium can confirm that BeNatural is functioning very well, in an open and collaborative framework, actively reaching all

planned objectives. The consortium identified the **following break-through achievements:** The newly designed nanofibers and nanotubes were proven to bind various metals, which is a very encouraging result for the continuation of the project. Proof-of-principle was obtained by showing that nanofibers and nanotubes could be aligned by dielectrophoresis, which marks a pivotal point for their parallel assembly and their further integration in microsystems. In addition, very encouraging results were obtained concerning the use of self-assembled peptides in optic nerve regeneration, following axotomy. All these results lay beyond our planned timing and they affirm the feasibility of the major goals of BeNatural.