TOWARDS A COORDINATED CALL
WITH CHINA
ON BIOMATERIALS RESEARCH

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European Commission
DG RTD – Directorate Industrial Technologies
Unit G3: Added Value Materials
Executive Summary

2nd China – Europe Symposium on Biomaterials in Regenerative Medicine

Barcelona 16-20th November 2009
(abstract, page 1-8)
2nd China-Europe Symposium on Biomaterials in Regenerative Medicine

16-20th November 2009 | Barcelona, Palau de la Música Catalana, el Petit Palau
Executive summary

The 2nd China-Europe Symposium on Biomaterials in Regenerative Medicine was held in Barcelona from 16 to 20th November 2009.

The symposium, jointly organized by the European Society for Biomaterials (ESB) and the Chinese Committee for Biomaterials (CCBM), was hosted by the Institute for Bioengineering of Catalonia.

After the successful first joint symposium held in Suzhou (China) on April 2006, this second meeting was a perfect opportunity for Chinese and European researchers to gather together again. Last highlights and achievements in biomaterials and tissue engineering were presented and future trends and challenges were discussed. The meeting offered a suitable platform for networking and partnering and to foster EU-China collaborations.

The opening ceremony was chaired by the General Director of the Ministry of Innovation, Universities and Enterprises of the Generalitat de Catalunya, Dr. Joan Roca, accompanied by the vicerrectors of research of both the University of Barcelona (Dr. Jordi Alberch) and the Technical University of Catalonia (Dr. Francesc Xavier Gil), by Mr. Zhiwei Wang from the Chinese Embassy in Spain and Dr. Renzo Tomellini, representative of the European Commission.
As a proof of the interest for reinforced cooperation, the European Society for Biomaterials (ESB) and the Chinese Committee for Biomaterials signed during the symposium a Memorandum of Understanding in order to promote the collaboration between European and Chinese researchers and to foster the exchange of talent.

The symposium had a total of 152 attendants from several countries. Next figure shows the distribution of attendants by origin.

Given the success of the symposium the third edition is already planned in 2011 in China.
Scientific programme

The call for abstracts was launched in April 2009. 168 communications were received. After a peer-review by the scientific committee, 87 abstracts were selected for an oral presentation and 67 abstracts were selected for a poster presentation.

The final programme included 75 oral presentations and 49 posters. In addition there were 5 keynote lectures:

- Dr. Renzo Tomellini, Head of Unit "Added-value Materials", European Commission: Materials in the knowledge-society and the role of the EU 7th Framework Programme
- Prof. Dr. Cui, Tsinghua University, China: The regulation of neural stem cells by chemical groups
- Prof. Dr. Kirkpatrick, Joannes Gutenberg University, Germany: Biomaterials for Nanoparticle Delivery Systems: In Vitro Models for Targeting the Lung
- Prof. Dr. Zhang, Sichuan University, China: Collagen-based gels inducing chondrogenic differentiation of MSCs
- Prof. Dr. Van Blitterswijk, University of Twente, the Netherlands: Materiomics: dealing with complexity in tissue engineering
Organization structure

Chairmen

- Prof. Luigi Ambrosio, Institute of Composite and Biomedical Materials (Italy)
- Prof. Zhongwei Gu, Sichuan University (China)
- Prof. Josep A. Planell, Institute for Bioengineering of Catalonia - Technical University of Catalonia (Spain)
- Prof. Xingdong Zhang, Sichuan University (China)

Scientific Committee

- Prof. Mario Barbosa, Instituto Nacional de Ingenharia Biomédica (Portugal)
- Prof. Serena Best, University of Cambridge (UK)
- Prof. Jiang Chang, Shanghai Institute of Ceramics, Chinese Academy of Sciences (China)
- Prof. Fuizhai Cui, Tsinghua University (China)
- Prof. Michael Doser, Institute for Textil- and Process Engineering (Germany)
- Prof. Changyou Gao, Zhejiang University (China)
- Prof. Pedro Granja, Instituto Nacional de Ingenharia Biomédica (Portugal)
- Prof. Dirk Grijpma, University of Twente (The Netherland)
- Prof. Nan Huang, Southwest Jiaotong University (China)
- Prof. James Kirkpatrick, Johannes Gutenberg University (Germany)
- Prof. Yang Leng, Hongkong University of Science and Technology (China)
- Prof. Wei Liu, National Center for Tissue Engineering, Shanghai Second University of Medicine (China)
- Prof. Antonio Merolli, Catholic University (Italy)
- Prof. Etienne Schacht, Ghent University (Belgium)
- Prof. Lucy Di Silvio, King's College London (UK)
- Prof. Elizabeth K. Tanner, University of Glasgow (UK)
- Prof. Shenguo Wang, Institute of Chemistry Chinese Academy of Sciences (China)
- Prof. Gao Changyou, Zhejiang University (China)
- Prof. Li Shipu, Wuhan University of Technology (China)
- Prof. Xi Tingfei, National Institute for the Control of Pharmaceutical and Biological Products (China)
- Prof. Wang Yingjun, South China University of Technology (China)
Local Organizing Committee

- Prof. Josep A. Planell (Institute for Bioengineering of Catalonia - Technical University of Catalonia)
- Prof. Maria Pau Ginebra (Technical University of Catalonia)
- Prof. F. Xavier Gil (Technical University of Catalonia)
- Dr. Elisabeth Engel (Institute for Bioengineering of Catalonia - Technical University of Catalonia)
- Dr. Damien Lacroix (Institute for Bioengineering of Catalonia)
- Dr. José María Manero (Technical University of Catalonia)
- Dr. Daniel Rodríguez (Technical University of Catalonia)
ANNEX II

Report

2nd China – Europe Symposium on Biomaterials in Regenerative Medicine

Barcelona 16-20th November 2009
The 2nd China-Europe Symposium on Biomaterials in Regenerative Medicine was held in Barcelona from 16 to 20th November 2009. After the successful first joint symposium held in Suzhou (China) on April 2006, this second meeting was a perfect opportunity for Chinese and European researchers to gather together again.

The symposium, jointly organized by the European Society for Biomaterials (ESB) and the Chinese Committee for Biomaterials (CCBM), was hosted by the Institute for Bioengineering of Catalonia and chaired by:

- **Prof. Luigi Ambrosio**, ESB President (Italy)
- **Prof. Xingdong Zhang**, CCBM President (China)
- **Prof. Josep A. Planell**, Conference Chairman (Spain)
- **Prof. Zhongwei Gu**, CCBM Vice-President (China)

The call for abstracts was launched in April 2009. 168 communications were received. After a peer-review by the scientific committee, 87 abstracts were selected for an oral presentation and 67 abstracts were selected for a poster presentation.

The symposium had a total of 152 attendants from several countries: 120 from Europe, 30 from China and 2 from other countries. Given the success of the symposium and to continue the cooperation the third conference is already planned for April 2011 in China.

The opening ceremony was chaired by the General Director of the Ministry of Innovation, Universities and Enterprises of the Generalitat de Catalunya, Dr. Joan Roca, accompanied by the vice-rectors of research of both the University of Barcelona (Dr. Jordi Alberch) and the Technical University of Catalonia (Dr. Francesc Xavier Gil), by Mr. Zhiwei Wang from the Chinese Embassy in Spain and Dr. Renzo Tomellini, representative of the European Commission.

As a proof of the interest for enhanced cooperation, the President of the European Society for Biomaterials (ESB) and the President of the Chinese Committee for Biomaterials (CCBM) signed a Memorandum of Understanding in order to promote the collaboration between European and Chinese researchers and to foster the exchange of talents. The bullet points of the agreement are:

- to promote the exchange of academic staff and PhD students among Universities and Research Institute members of the ESB and/or CCBM;
- to promote the establishment of scientific cooperation in the fields of mutual interest;
- to render mutual assistance in raising the scientific qualifications of the academic staff;
- to promote the exchange of publications and documentation on current research;
- to promote industrial cooperation;
- to share experiences in developing better teaching methods and techniques;
- to organize bilateral joint symposia, workshops and conferences;
- to realize, wherever possible and of mutual interest, joint research programs and projects.
The scientific program of the conferences was focused on the last highlights and achievements in biomaterials and tissue engineering and future trends and challenges were discussed. The final programme included 75 oral presentations and 49 posters. In addition there were 5 keynote lectures:

- Dr. Renzo Tomellini, Head of Unit "Added-value Materials", European Commission: “Materials in the knowledge-society and the role of the EU 7th Framework Programme”.
- Prof. Dr. Fu-Zhai Cui, Tsinghua University, China: The regulation of neural stem cells by chemical groups.
- Prof. Dr. C. James Kirkpatrick, Johannes Gutenberg University, Germany: “Biomaterials for Nanoparticle Delivery Systems: In Vitro Models for Targeting the Lung”
- Prof. Dr. Xingdong Zhang, Sichuan University, China: “Collagen-based gels inducing chondrogenic differentiation of MSCs”.
- Prof. Dr. Clemens Van Blitterswijk, University of Twente, the Netherlands: “Materiomics: dealing with complexity in tissue engineering”.

The meeting was able to gather a huge amount of information on the conference topic and offered a suitable platform for networking and partnering and to foster EU-China collaborations. Based on the scientific content of the conference program (see attached documents) and following specific meetings between ESB and CCBM delegations during the conference, topics were selected to define the common platform for future collaborations.

In this direction, the development of multi-functional biomaterials is proposed together with the implementation of advanced technologies to manage the complexity and monitor information exchanged between biological cues and materials. The rational design of biomaterial multi-functionality is considered to involve biological microenvironmental parameters, biomolecule inclusion, biomaterial degradation mechanisms, modelling and combination of preparation technologies.

The target is to develop integrated technologies for designing custom-made structures assuring efficacy, scalability, quality, and safety for tissue repair/regeneration, that are fundamental for the industrialisation process.

Following the meeting of the ESB and CCBM representatives, four major topics were chosen that will lead to well-defined research activities:

- Imaging & Rapid Micro/Nano Prototyping Technology for Custom Made Scaffolds.
- Modeling Techniques of Scaffold / Biological Entities
- Nano/Micro Mechanical Bio-Functions for Controlled Tissue Repair/Regeneration
- Systematic Development of Artificial Stem Cell Niches For Tissue Regeneration

**IMAGING & RAPID MICRO/NANO PROTOTYPING TECHNOLOGY FOR CUSTOM MADE SCAFFOLDS.**

**Technical Content/Scope:** Different techniques have been developed to fabricate 3D porous scaffolds, each characterized by its own advantages and limitations. The introduction of rapid prototyping technologies in the biomedical field has led to a division of scaffold fabrication
techniques into two groups, defined as “conventional” and “novel” methods. In particular, conventional methods are defined as processes to obtain scaffolds that are characterized by continuous, uninterrupted pore structure, however lacking any long-range channelling micro-architecture. Basically, these techniques include fiber meshes/fiber bonding, gas foaming, solvent casting/particulate leaching, phase separation, melt moulding, freeze drying, solution casting, emulsion freeze drying.

By using these conventional scaffolds techniques it is difficult to control all the structural properties and they need to be shaped with custom-made moulds. Conversely, the technology transfer of solid freeform fabrication (SFF) to tissue engineering represents the key to produce customised scaffolds with reproducible internal morphology. This allows for a higher degree of architectural control, making structures to increase the mass transport of oxygen and nutrients throughout the scaffold.

SFF is a collective term for a group of technologies that can manufacture objects in a layer-by-layer fashion from the 3D computer design of the object. SFF was initially developed for fabricating prototype engineering parts, thus the name “rapid prototyping” (RP) is also widely used.

Even though there are several commercial variants of SFF technology that differ significantly in the way they build up 3D models, they are characterized by three basic steps in their process: data input, data file preparation, and object building. In particular, the general process involves producing a computer-generated model using computer-aided design (CAD) software.

If data source is obtained from Computed Tomography (CT) or Magnetic Resonance Imaging (MRI), medical scans can be used to create a customised CAD model and consequently a scaffold which should be characterized by the exact external shape required to correct the damaged tissue site.

Accordingly, customised scaffolds for tissue engineering (repair/regeneration) may be designed and manufactured by integrating different techniques such as image capture (i.e. computed tomography or MRI scans), 3D modelling and rapid prototyping with those related to the preparation of polymer, ceramic and nano/micro-composite materials for tissue repair/regeneration processing.

The partnership should also integrate industrial partners

**Expected Impact:** A systematic technological approach should be created that allows the development of techniques and software able to produce custom-made structures for the repair/regeneration of various tissues. The projects are expected to produce knowledge-based technology with a clear clinical added value leading to industrial competitiveness.

**MODELING TECHNIQUES OF SCAFFOLD / BIOLOGICAL ENTITIES**

**Technical Content/Scope:** Computational simulations will become a more and more important tool in the development of biology and bioengineering. Thus, the development of modeling techniques in the area of biomaterials will be essential for the development of new products and the understanding of scaffold / biological entities interactions. The mechanical design of scaffolds is now well understood and simulations of some biological processes have
already been made. In the future, a focus will be placed on the development of numerical
techniques able to simulate over time the interactions of cells and

biomolecules with the physical, chemical, and biochemical properties of the scaffold. In
addition, cell / cell interactions will be simulated in order to account for the spatiality and
temporality of each cell stage within the constructs.
This will lead to the simulation of cell attachment, cell proliferation, cell migration and cell
differentiation in interaction with the properties of the scaffold. Other biological processes
such as angiogenesis or drug release will be also modeled. With the progress of imaging
techniques more and more multiscale patient or sample-specific studies will be conducted
from the nanoscale to the organ scale.
Moreover, models will become less and less deterministic with the introduction of stochastic
processes to describe scaffold / cell interactions and cell / cell interactions. The progress of
modeling techniques of scaffold / biological entities will therefore decrease the use of in vitro
and in vivo tests by screening out irrelevant constructs.

Expected Impact: A defined model to be applied for different tissues, cells and parameters to
predict materials/biological entities at in vitro and in vivo level. The projects are expected to
produce knowledge-based technology to be implemented at clinical level.

NANO/MICRO MECHANICAL BIO-FUNCTIONS FOR CONTROLLED TISSUE
REPAIR/REGENERATION

Technical Content/Scope: Nanometre and micrometre-range features on the surface of
biomaterials critically determine the biological and cellular responses in terms of
inflammation, formation of fibrotic tissue and ability to closely mimic the extracellular
matrix. In turn these responses dictate the functional success or failure of the material.
The main scope is to develop new strategies and insights into the development of novel, bio-
inspired materials with improved biomimicry as a result of closely controlled nanoscale
engineering of material surface features including nano-rugosity, topography, wettability
(hydrophobicity / hydrophobicity) and biospecificity.
These surfaces should provide a template foundation with, and/or appropriate anchors for,
controlled surface functionalisation with synthetic macromolecules able to mimic components
of the extracellular matrix, retain and release growth factors and incorporate other functional
groups capable of controlling tissue repair/regeneration in a 3D environment.
Nano-scale surface engineering should also be geared towards the mechanical properties of
the materials to ensure ‘appropriate fit’ with the intended final application including
environment/stimuli-sensitive and -responsive capabilities.

The partnership should also integrate industrial partners as well as experts in regulatory
frameworks.

Expected Impact: A flexible technological platform should be created that allows the
standardised commercialisation and use of the surface modification methods in various
clinical scenarios. The projects are expected to impact on both knowledge and clinical
practice and to produce knowledge-based technology with a clear clinical and commercial
added value leading to industrial competitiveness.
SYSTEMATIC DEVELOPMENT OF ARTIFICIAL STEM CELL NICHES FOR TISSUE REGENERATION

**Technical Content/Scope:** Adult stem cells are widely recognised as the clinical solution for the treatment of damaged tissues and organs. Despite their well-established tissue regeneration potential, the use of these cells in cell therapy is still limited by their clear identification and manipulation procedures prior to implantation. Stem cell expansion from an undifferentiated phenotype as well as the control of their differentiation to a specific cell type are still hampered by the absence of suitable culture substrates and media. In addition, their clinical efficacy in vivo is impaired by the lack of suitable carriers. Evidence is emerging which indicates that the proliferation and differentiation of stem cells in their natural niches is controlled by a combination of factors; many of which are still unknown.

Projects should aim at defining the physico-chemical, biochemical and cellular parameters controlling the stem cell microenvironment and at developing synthetic culturing conditions able to control adult stem cell behaviour throughout the in vitro manipulation process and implantation course. Multifunctional extracellular matrix components and synthetic pro-morphogens should be integrated to form bioactive biomaterials capable of mimicking the stem cell niches of various tissues. To this purpose, projects should integrate a multi-disciplinary team capable of taking the concept from research to bed side.

The partnership should also integrate industrial partners as well as experts in both regulatory frameworks.

**Expected Impact:** A flexible technological platform should be created that allows the standardised commercialisation and use of stem cells in various clinical scenarios. The projects are expected to impact on both knowledge and clinical practice and to produce knowledge-based technology with clinical and commercial added value leading to industrial competitiveness.
ANNEX III

Signed Agreement for scientific cooperation

between the European Society for Biomaterials

and the Chinese Committee for Biomaterials
AGREEMENT

For scientific cooperation
between
The European Society for Biomaterials
and
The Chinese Committee for Biomaterials

The European Society for Biomaterials and the Chinese Committee for Biomaterials, conscious of the aspiration to extend international cooperation and having common intentions in the field of scientific research and education, have agreed on the following basic principles of cooperation:

Paragraph 1
The purpose of the Agreement is to promote cooperation in the area of Biomaterials Science and Education between the European Society for Biomaterials (ESB) and the Chinese Committee for Biomaterials (CCBM) in the fields of mutual interest.

Paragraph 2
For the realization of these objectives, both ESB and CCBM agree:
➢ to promote the exchange of academic staff and PhD students among Universities and Research Institute members of the ESB and/or CCBM;
➢ to promote the establishment of scientific cooperation in the fields of mutual interest;
➢ to render mutual assistance in raising the scientific qualifications of the academic staff;
➢ to promote the exchange of publications and documentation on current research;
➢ to promote industrial cooperation;
➢ to share their experiences in developing better teaching methods and techniques;
➢ to organize bilateral joint symposia, workshops and conferences;
➢ to realize, wherever possible and of mutual interest, joint research programs and projects.

Paragraph 3
Both ESB and CCBM agree that the best forms of cooperation are through direct initiative and connections among Universities and Research Institute members of the ESB and/or CCBM, based on personal and institutional interests, and in a form that is most suitable to the parties.

Paragraph 4
Both ESB and CCBM will agree on what scientific cooperation between the parties will be implemented on the basis of the Working programs signed by the representatives of both ESB and CCBM and the representatives of involved institutions for coordination of conditions, topics and participants of scientific cooperation. This agreement does not commit either ESB or CCBM to directly funding the program.

Paragraph 5
Both ESB and CCBM are entitled to propose amendments to be made to current
Agreements. In order to become effective the amendments must be recognized by both Parties in a joint protocol or memorandum.

**Paragraph 6**

The Agreement has been prepared in two original copies in English.

**Paragraph 7**

The Agreement will come into force on the date of signature and is valid for a period of 5 (five) years, unless one Party notifies the other in writing of its wish to terminate the Agreement at least three months prior to the end of a calendar year provided that all existing obligations assumed in terms of the Agreement will be fulfilled.

On behalf of European Society for Biomaterials Prof. Luigi Ambrosio, President

Date: Barcelona, 16 Nov, 2009

On behalf of Chinese Committee for Biomaterials Prof. Xingdong Zhang, President

Date: Barcelona, 16 Nov, 2009

Addresses:
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ANNEX IV

Administrative arrangement between

the National Natural Science Foundation of China

and The Directorate-General for Research of the European Commission

to implement Coordinated Calls
ADMINISTRATIVE ARRANGEMENT
between
The National Natural Science Foundation of China
and
The Directorate-General for Research of the European Commission
to implement Coordinated Calls

Considering the Agreement on Scientific and Technological Cooperation between the European Community and the Government of the People's Republic of China signed in December 1998 and last renewed in December 2009, taking account of the discussions at the 8th meeting of the Steering Committee set up under the above mentioned Agreement held in Beijing on the 10th of November 2009, the National Natural Science Foundation of China (NSFC) and the Directorate-General for Research of the European Commission (DG RTD) are planning to launch research projects in specific research areas of common interest.

Objective and Scope

The two sides intend to implement Coordinated Calls. NSFC and the European Commission will jointly select specific research areas of common interest in which coordinated calls are expected to be launched. For this purpose they will consult, if necessary, scientific experts from Europe and China and they may consider organising joint events, such as workshops. The selected research area(s) will be integral parts of their respective research programmes.

The Coordinated Calls will lead to projects to be financed by the European Union and by the NSFC.

The first coordinated call(s) will be launched as soon as possible. Each side will publish the call(s) for proposals following their rules and regulations.

Both sides will agree on the budgetary resources devoted to each coordinated call, on the indicative size and duration of the projects to be funded and on the expected timeframe for launching the projects.

The NSFC and DG RTD will regularly consult each other on the implementation of the projects. The Steering Committee of the S&T Agreement will be regularly informed on the content and implementation of the coordinated call(s), on the provisional budget, and the approximate number, size and duration of the foreseen projects.

Evaluation and selection of projects

The proposal presented in response to the calls should contain the research to be carried out by all participants. The evaluation panels will be composed of independent experts from the EU and China. All costs in relation with the evaluation of proposals presented in response to the European Union call will be covered by the EU.
To be eligible, a proposal will have to meet the requirements set out in the call for proposals to which it responds. It is desirable that proposals are balanced, both in terms of number of partners and in terms of manpower devoted to the research projects by each side.

The Evaluation Panels will draw up ranking lists with the proposals which have successfully passed the evaluation. Both sides will follow the order of the ranking list in their respective decision processes, in accordance with their respective laws and procedures.

**Contracting and start of the closely-coordinated project(s)**

The selected projects will start after the signature with the European Commission of the Grant Agreement (GA) by the European participants and of the signature of the NSFC contract by the Chinese participants. The Grant Agreement and the NSFC contract will have a technical annex, describing the research to be carried out.

The participants in the projects from both sides will be invited to sign a Coordination Agreement (CA) between them, which will address concrete management issues that may arise during the projects implementation, as well as their agreements on Intellectual Property Rights issues.

Each side will fund its participants.

The present administrative arrangement does not create obligations binding under international law.

Done in duplicate in Brussels on 26 March 2010.

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Han Jianguo  
Director General  
Bureau of International Cooperation  
National Natural Science Foundation of China

José Manuel Silva Rodríguez  
Director General  
EC Directorate-General for Research