SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

Wednesday 17 to Friday 19 June 2015
Madrid – Spain

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CERAMIC & GLASS SCIENCE & TECHNOLOGY,
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Program

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Program of day 1

Wednesday 17th June

General introduction on ceramics and glass materials, overview of properties, comparison with living hard tissues (bones) and their interaction with biomaterials

AM: from 9.00 to 12:45

9:00	**Welcome to the Institute of Ceramic and Glass** *Fausto Rubio, Director*	
9:10	**General introduction** *Francis Cambier (BCRC, Mons, Belgium)*	20 min
9:30	**1A - Ceramics: a general overview** *Elizabeth Kupp (Penn State Univ., PA, USA)*	1:20 + 10 min q/a
11:00	Coffee break	
11:15	**1B - Glasses and glass ceramics: a general overview** *Maria Jesus Pascual (ICyV, Madrid, Spain)*	1:20 + 10 min q/a
13:00	Lunch in the campus restaurant	

PM: from 14:30 to 19:30

14:30	**1C - Bone: structure and properties** *Fernando J Monteiro (INEB, Univ. Porto, Portugal)*	1:20 + 10 min q/a
16:00	**1D - Biological responses of cells and tissues to biomaterials** *Marianna Peroglio (AO Fundation, Davoz, Switzerland)*	1:20 + 10 min q/a
17:30	Coffee break	
17:45	**1E - Biocompatibility and *in vitro* tests** *Maria Helena Fernandes (FMDUP, Univ. Porto, Portugal)*	35 min + 10 min q/a
18:30	**Round table q/a -** *Moderators: Francis Cambier (BCRC, Mons, Belgium), Jérôme Chevalier (INSA Lyon, France) and Gary Messing (Pennsylvania State University, USA)*	1:00
21:00	Dinner on site	

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Program of day 2

Thursday 18th June

Structural ceramics for implants: applications, properties and process

AM: from 9:00 to 13:15

9:00	**2A - On the history of bio-ceramics for hip joint replacement** *Corrado Piconi, (ENEA, Italy)*	1:20 + 10 min q/a
10:30	Coffee break	
10:45	**2B - The answer of bioceramics to long-term mechanical demands** *J Chevalier (INSA Lyon, France)*	50 min + 10 min q/a
11:45	**2C – Spectroscopic analyses for the characterization of bioceramics** *V Sergo (University of Trieste, Italy)*	50 min + 10 min q/a
12:45	Lunch in the campus restaurant	

PM: from 14:30 to 16:00

14:30	**2D - Processing: the industry point of view** *Meinhard Kuntz (Ceramtec, Germany)*	1:20 + 10 min q/a
17:30	Sightseeing nearby Madrid	
21:00	Dinner in a nearside village (bus transportation)	

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Program of day 3

Friday 19th June

Bioactive ceramics and glasses, tissue engineering, surgical procedures

AM: from 9:00 to 13:15

9:00	**3A - Calcium phosphate ceramics** *Maria Pau Ginebra (UPC, Barcelona, Spain)*	50 min + 10 min q/a
10:00	**3B - Bio-glasses and glass-ceramics** *Stuart Hampshire (Limerick Univ., Ireland)*	50 min + 10 min q/a
11:00	Coffee break	
11:15	**3C - Bio-cements** *Eamonn de Barra (Limerick Univ., Ireland)*	50 min + 10 min q/a
12:15	**3D - Processing of bioceramic scaffolds: state of the art and current trends** - *Anne Leriche (Univ. Valenciennes, France)*	50 min + 10 min q/a
13:30	Standing lunch at the ICV	

PM: from 14:30 to 17:15

14:30	**3E - Tissue engineering: concepts and applications** *Yannis Missirlis (Univ. Patras, Greece)*	50 min + 10 min q/a
15:30	**3F - Surgical procedures: dental and orthopedic implants** *Jan Willem Hoekstra (Radboud university, Netherlands)* *Jose Antonio de Pedro (Orthopedic surgeon U. Salamanca - Spain)* *Antonio Pérez Caballer (Orthopedic surgeon U. Francisco de Vitoria, Madrid - Spain)* *Moderator: Julio San Roman (ICTP, CSIC, Spain)*	1:20 + 10 min q/a
17:00	**Concluding remarks** *Jérôme Chevalier (INSA Lyon, France)*	
17:30	Refreshments	

List of Participants

First Name	Last Name	Company / Institution / Laboratory	City	Country	Email
Abedulkadir	Abudalleh Al-Azawi	Institute of Experimental Morphology, Pathology and Anthropology with museum	Sofia	Bulgaria	alkader78mah@yahoo.com
Jonathan	Acheson	Queen's university Belfast	Belfast	United Kingdom	jacheson07@qub.ac.uk
Matthias	Agne	Drexel University	Philadephia	USA	mta37@drexel.edu
Antonio	Arena	Centro ceramico - University of Bologna -DICAM-DIBINEM	BOLOGNA	Italy	antonio.arena3@unibo.it
Alberto	Ballardini	CNR-ISTEC-Italy	Faenza (RA)	Italy	alberto.ballardini@istec.cnr.it
Silvia	Barbi	University of Modena and Reggio Emilia	Modena	Italy	silvia.barbi@unimore.it
Irina	Bliznakova	Bulgarian Academy of Sciences	Sofia	Bulgaria	irbliznakova@abv.bg
María	Canillas	Ceramic and Glass Institute from CSIC	Madrid	Spain	mcanillas@icv.csic.es
Shaan	Chamary	LMCPA-Université de Valenciennes et du Hainaut Cambrésis	Maubeuge	France	shaan.chamary@univ-valenciennes.fr
Aleksandra	Chilikina	University of Limerick	Limerick	Ireland	aleksandra.chilikina@ul.ie
Eva	Chinarro	Ceramic and Glass Institute from CSIC	Madrid	Spain	martin@icv.csic.es
Catarina	Coelho	Fluidinova SA	Moreira da Maia	Portugal	catarina.coelho@fluidinova.pt
Antonio	De Aza Moya	Ceramic and Glass Institute from CSIC	Madrid	Spain	aaza@icv.csic.es
Marion	Dehurtevent	Laboratoire de Matériaux Céramique et Procédés Associés (LMCPA)/Univesité de Valenciennes	Maubeuge	France	marion.dehurtevent@univ-lille2.fr
Benjamin	Delattre	Umons Laboratoire de Physique des Surfaces et Interfaces	Mons	Belgium	benjamin.delattre@umons.ac.be
Hamada said Abdelwahab	Elsayed	Department of Industrial Engineering, University of Padova, Italy	Padova	Italy	Hamada.elsayed@dii.unipd.it
Aisling	Feen	University of Limerick	Limerick	Ireland	aisling.feen@ul.ie
Sònia	Font Tellado	Experimental Trauma Surgery, Technical University Munich	Munich	Germany	sonia.font@tum.de
Erkka	Frankberg	Tampere University of Technology, Department of Materials Science, Ceramic materials group	Tampere	Finland	erkka.frankberg@tut.fi
Ana	Gantar	Jozef Stefan Institute	Ljubljana	Slovenia	ana.gantar@ijs.si
Cristina	Guerrero Lecuona	Instituto de Cerámica y vidrio	Madrid	Spain	cguerrero@icv.csic.es
Dominique	Hautcoeur	Belgian Ceramic Research Centre	Mons	Belgium	d.hautcoeur@bcrc.be
Michal	Hicak	Institute of Inorganic Chemistry, department of Ceramics	Bratislava	Slovakia	michal.hicak@savba.sk
Sam	Hollings	University of York, Department of Biology, Biomedical Tissue Research	York	United Kingdom	sh1462@york.ac.uk
Ian	Houlihan	University of Limerick	Limerick	Ireland	ian.houlihan@ul.ie
Beata	Kaczmarek	Nicolaus Copernicus University	Torun	Poland	beatakaczmarek8@gmail.com
Maura	Kelleher	Dublin Institute of Technology	Dublin	Ireland	maura.kelleher@dit.ie
Olga	Kuten	Lacerta Technologies GmbH	Krems an der Donau	Austria	olga.kuten@lacertatech.com

First Name	Last Name	Company / Institution / Laboratory	City	Country	Email
Karolina	Łączka	AGH University of Science and Technology, Faculty of Material Science and Ceramics, Departament of Glass Technology and Amorphous Coatings	Cracow	Poland	karolina.laczka@gmail.com
Marie	Lasgorceix	Belgian Ceramic Research Centre	Mons	Belgium	marie.lasgorceix@etu.unilim.fr
Alethea	Liens	Université de Lyon, INSA-Lyon, Laboratoire MATEIS, UMR CNRS 5510	VILLEURBANNE	France	alethea.liens@insa-lyon.fr
Hannah	Little	Queen's university Belfast	Belfast	N.Ireland	hlittle03@qub.ac.uk
YuHao Liu	Liu	Universty of Illinois at Urbana Champaign	Urbana	USA	liu104@illinois.edu
Marcin	Malek	Material Science and Engineering Warsaw University of Technology	Warsaw	Poland	marcin.malek@inmat.pw.edu.pl
Elena	Mancuso	Newcastle University	Newcastle upon Tyne	United Kingdom	e.mancuso@ncl.ac.uk
Joana	Mesquita Guimarães	ERMAT - Universidade Federal de Santa Catarina	Florianópolis	Brazil	mesquitaguimaraesjoana@gmail.com
Gary	Messing	The Pennsylvania State University	University Park	USA	messing@matse.psu.edu
Aleksandra	Miazga	Warsaw University of Technology, The Faculty of Materials Science and Engineering	Warsaw	Poland	aleksandramiazga86@gmail.com
Marta	Michalska	Department of Chemistry of Biomaterials and Cosmetics, Faculty of Chemistry, Nicolaus Copernicus University in Torun	Torun	Poland	mm@doktorant.umk.pl
Ali	Mohammadkhah	Materials research Center at Missouri S&T	Durham; NC	USA	amkv6@mst.edu
Helena	Montazeri	Landspitali University/ The Blood bank	Reykjavík	Iceland	helena.montazeri@gmail.com
Berta	Moreno	Ceramic and Glass Institute from CSIC	Madrid	Spain	berta@icv.csic.es
Arkaitz	Mucientes Ruiz	Hospital Clinico San Carlos	Tres Cantos	Spain	arkaitz. mucientes@salud. madrid.org
Nuno	Neves	Innovnano, Materiais Avançados S.A	Coimbra	Portugal	Nuno.Neves@innovnano-materials.com
Camille	Ortali	Université de Limoges – Laboratoire SPCTS	Limoges	France	camille.ortali@etu.unilim.fr
Pilar	Pena Castro	Ceramic and Glass Institute from CSIC	Madrid	Spain	ppena@icv.csic.es
Zahra	Pishgahi Fard	University of Sheffield	Sheffield	United Kingdom	z.pishgahi-fard@sheffield.ac.uk
Lucia	Pontiroli	Oral Biology - University of Leeds	Leeds	United Kingdom	dnlp@leeds.ac.uk
Zuzana	Pramukova	slovak Academy of Sciences/Institute of Materials Research/Department of Structural Ceramics	Kosice	Slovak Republic	zpramukova@gmail.com
Laura	Preiss	INSA Lyon	Villeurbanne	France	laura.preiss@insa-lyon.fr
Silvia	Ramirez	Mateis Laboratory, INSA Lyon	Villeurbanne	France	silvia-stella.ramirez-caballero@insa-lyon.fr
Erica	Roitero	Universitat Politècnica de Catalunya - Dept. of Materials Science and Metallurgical Engineering	Barcelona	Spain	erica.roitero@upc.edu
Rocio Estefanía	Rojas Hernandez	Instituto de Cerámica y vidrio, Departamento Electrocerámica	Madrid	Spain	rociorojas@icv.csic.es
Francesca	Salamanna	Rizzoli Orthopaedic Institute-RIT Depatment, Biocompatibility, Technological Innovations and Advanced Therapies Laboratory	Bologna	Italy	francesca.salamanna@ior.it

First Name	Last Name	Company / Institution / Laboratory	City	Country	Email
Maria	Sartori	Rizzoli Orthopaedic Institute-RIT Depatment, Biocompatibility, Technological Innovations and Advanced Therapies Laboratory	Bologna	Italy	maria.sartori@ior.it
Sarah	Sayed	University of Limerick	Limerick	Ireland	sarah.sayed@ul.ie
Jana	Sekaninová	CEITEC BUT- Central European Institute of Technology Brno	Brno	Czech Republic	jana.sekaninova@ceitec.vutbr.cz
Sara	Sequeira	Department of Materials and Ceramic Engineering	Aveiro	Portugal	s.sequeira@ua.pt
Marina	Sokolova	Riga Technical University Rudolfs Cimdins Riga Biomaterials Innovation and Development Centre	Riga	Latvia	marina.sokolova@rtu.lv
Tibor	Sopčák	Institute of Materials Research - Slovak Academy of Sciences	Kosice	Slovak Republic	tsopcak@imr.saske.sk
Anja	Thust	Goethe University Frankfurt am Main, Institute of Geosciences, Crystallography	Frankfurt am Main	Germany	thust@kristall.uni-frankfurt.de
Jana	Vecstaudza	Riga Technical University, Institute of General Chemical Engineering	Riga	Latvia	jana.vecstaudza@rtu.lv
Federico	Veronesi	ISTEC-CNR	Faenza	Italy	federico.veronesi@istec.cnr.it
Francesca	Veronesi	Rizzoli Orthopedic Institute, Laboratory of Preclinical and Surgical Studies	Bologna	Italy	francesca.veronesi@ior.it
Javier	Villalba	The Pennsylvania State University	Madrid	Spain	jav5318@psu.edu
David	Wiedmer	UIO – Faculty of Dentistry - Department of Biomaterials	Oslo	Norway	daviwie@odont.uio.no

Trainers
and short abstracts of their presentations

Elizabeth R. Kupp

Director, Advanced Materials Processing Laboratory; Sr. Research Associate
The Pennsylvania State University, Dept. of Materials Science and Engineering

kupp@matse.psu.edu
+1 814-863-5540

Short biography: Dr. Kupp received B.S. and Ph.D. degrees from Penn State University in 1984 and 1995, respectively. In the interim, she worked at Kennametal, Inc. She subsequently did postdoctoral work at Oak Ridge National Laboratory. She is currently working in the area of ceramic processing at Penn State, where she has performed research on transparent ceramics for laser gain media, foamed ceramics for particulate filters, thermomechanical studies on solid oxide fuel cell cathode materials, sintering studies of alumina and additive manufacturing of technical ceramics.

Short institution presentation: The Department of Materials Science and Engineering (MatSE) at Penn State has ~30 faculty, 160 graduate students and 250 undergraduate students. We are located in the center of Pennsylvania on a campus of 45,000 undergraduate students enrolled in 11 colleges. Our faculty and students are involved in research spanning many topics in materials science, including, e.g., biomaterials, dielectric/piezoelectric materials, polymers, electrochemistry, semiconductors, mechanical properties, 2-D materials and computational materials.

Title of the lecture: **Ceramics: An Overview of Processing-Microstructure-Property Relationships**

Abstract: All materials scientists are taught the processing-properties-microstructure triangle. The processing of ceramic materials has a profound effect on their microstructures and, thus, properties. The processing aspect of the triangle is often overlooked, however, resulting in ceramics with properties that don't realize the potential of the materials from which they are made. Bioceramic applications have particularly stringent microstructure/property requirements to ensure reliable lifetime predictions and prevent potentially traumatic failures.
This presentation will provide an overview of ceramic processing from powder synthesis through forming and sintering and discuss the effects of each step on the microstructure and properties of the final parts. Special emphasis will be placed on applications, such as biomaterials, requiring "perfect" processing to achieve specific microstructure and property goals.

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Name Surname María Jesús Pascual	
Position Tenured Scientist Institute/Department Ceramics and Glass Institute (CSIC), Glass Department	
mail mpascual@icv.csic.es Telephone 917355840, Ext. 1211	

Short biography

Dr. María Jesús Pascual**,** Doctor in Chemistry (2000) from Autónoma University of Madrid (UAM), Spain. Tenured Scientist in the ICV (CSIC) since 2007. She has participated in 14 national projects, 7 international projects and 11 cooperation projects and integrated actions. She has supervised several Masters and PhD theses in the field of glasses and glass-ceramics and is co-author of more than 70 SCI papers. Secretary of the Glass Section of the SECV (Spanish Society of Ceramic and Glass) since 2008. Gottardi Prize in 2010 (given by the International Commission on Glass).

Short institution presentation

Ceramics and Glass Institute (ICV) is one of the 132 research centers of CSIC, the Spanish Research Council (http://www.icv.csic.es). It is organised in four departments: Ceramics, Electroceramics, Glasses and Physico-chemistry of surfaces and processes. The Glass Department of ICV founded in 1965 has become the most important research group in the field of glass materials in Spain. The research group GlaSS (http://grupoglass.tuars.com/joomla/) works with a double orientation: scientific research, financed with national public funds and technological research supported with contracts with companies and public projects of technological development as well.

Title of the lecture **Glasses and Glass-ceramics: a general overview**

Abstract

This is a general lecture about glasses and glass-ceramic materials, definitions, more relevant compositions, overview of structure and properties, main methods of preparation and characterization and crystallization studies. Different examples always applied to bioglasses and bioglass-ceramics will be given to illustrate the presentation. Covering all types of glasses: traditional, sol-gel, phosphate, borate, glass-ceramics, composites and hybrids.

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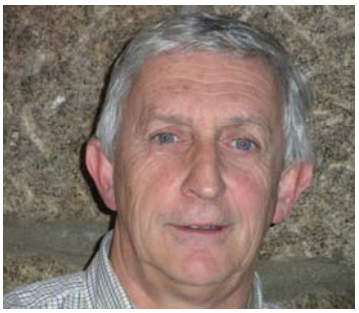
Fernando MONTEIRO

Professor
Department of Metallurgical and Materials Engineering DEMM
Faculty of Engineering University of Porto
INEB- Institute for Biomedical Engineering (University of Porto)

mail fjmont@ineb.up.pt
+351226074982



Fernando Monteiro, 60 years old, is a full professor at University of Porto and President of INEB (Porto-Portugal). He obtained his PhD in 1986 in surface coatings and was engaged as lecturer ever since. Started working in Biomaterials in 1988. Is a founding member of INEB- Institute for biomedical Engineering, (aprox. 180 people) and is the leader of a research group " Biocompostes". Within Biomaterials and tissue regeneration is favorite subjects are: NANOPHASED CERAMIC/POLYMER COMPOSITE SCAFFOLDS FOR TISSUE REGENERATION AND DRUG RELEASING;ANTIBACTERIAL BIOMATERIALS; CHEMISTRY AND TOPOGRAPHY CONTROLLED HARD CERAMIC SURFACES AND COATINGS FOR GUIDED TISSUE REGENERATION and NANOMATERIALS FOR SPECIFIC CELL TARGETING AND BIO-IMAGING. He has published 130 papers and 6 patents His h factor is 24 (Scopus).

Short institution presentation

INEB- Instituto de Engenharia Biomédica is a private non-profit association of public interest, founded in June 1989 by 6 institutions, including the University of Porto (UPorto). The Mission of INEB is to generate knowledge, promoting research, advanced training and technology transfer in biomedical engineering. INEB's Vision is to be an international reference in the application of integrated engineering solutions to improve human health. In 2008, 3 research institutes of Univ Porto, IBMC, INEB and IPATIMUP formed a consortium – I^3S (Institute for Research and Innovation in Health).Transdisciplinarity is a distinctive feature of INEB. Integrative research, involves biomaterials, tissue regeneration, nanomedicine, bioimaging, medical signals, geoepidemiology, biology, and medicine, bringing international recognition to the institute. 180 people work at INEB (58 PhDs and 82 post-grad. students), mostly young researchers (79% are less than 40 years old).

Title of the lecture - **Bone: structure and properties… and how to mimic it**

Abstract

Bone is an amazing tissue in humans, as in many other vertebrates. Bone tissue structure, composition and most relevant characteristics will be discussed aiming at foreseeing how it should be possible to mimic it. Diseases associated to bone loss account for very significant expenditure in Healthcare Two case studies on scaffolds based on typical constituents of bone extracellular matrix will be discussed and further examples will be presented, as part of strategies to regenerate bone tissue.

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Marianna Peroglio	
Research Scientist AO Research Institute Davos/Musculoskeletal Regeneration Program	
marianna.peroglio@aofoundation.org +41 (0)81 41 42 482	

Short biography

After a Master in Materials Engineering at the Politecnico of Turin (Italy), Marianna Peroglio focused her doctoral studies on composite porous materials for bone repair at the Institute of Applied Sciences of Lyon, France. In 2008, she joined the Musculoskeletal Regeneration Program of Prof. Mauro Alini at the AO Research Institute Davos, Switzerland. Since 2011, she is Research Scientist at the AO Research Institute Davos. Her research focuses on intervertebral disc regeneration using stem cells, hydrogels and homing approaches, and biomaterial development for bone repair based on surface modifications of metals and ceramics. She is involved in many collaborative projects, including the recent FP7 European Marie Curie ITN "Biobone" and the COST Action "Newgen".

Short institution presentation

With more than 10'000 surgeons in more than 100 countries, the AO Foundation is the world's leading education and research organization for the treatment of trauma and musculoskeletal disorders. The mission of the AO Research Institute Davos is to contribute high-quality research in selected areas of trauma and diseased musculoskeletal system, and to investigate the performance of surgical procedures, devices and substances to improve patient treatment. The Musculoskeletal Regeneration Program led by Prof. Mauro Alini develops biological approaches addressing pathologies of the musculoskeletal system, with a special focus on bone, intervertebral disc and cartilage. The ultimate goal is to define strategies to prevent degenerative disorders of the skeleton and to re-establish its functionality. The general expertise of the program lies in the combination of a cell therapy approach (*in vitro* and *ex vivo* studies, using mesenchymal stem cells for example) and the use of specifically-designed bioreactors allowing control over the tissue environment.

Title of the lecture: **Biological responses of cells and tissues to biomaterials**

Abstract

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FERNANDES Maria Helena	
Professor Faculty of Dental Medicine, University of Porto, Portugal	
mhfernandes@fmd.up.pt +351 220901100	

Short biography

Maria Helena Fernandes, born in 1958, received her PhD in 1986 at Imperial College of Science and Technology, University of London, UK. Currently, she is full Professor of Pharmacology and Therapeutics at the Faculty of Dental Medicine, University of Porto (FMDUP), Portugal. She coordinates the Laboratory for Bone Metabolism and Regeneration at FMDUP, with the research interests mainly focused on the pharmacology of bone remodeling and regeneration in normal and systemic compromised conditions, using in vitro and in vivo methodologies. Particular emphasis is put on the cellular interactions in regenerative strategies and on the biological response to biomaterials. The lab relies on multidisciplinary collaborations and on the involvement of many visiting researchers with a diverse scientific background, greatly contributing to translational knowledge in this area. She has authored over 130 peer-reviewed publications (h-index 24, WoS).

Short institution presentation

Faculty of Dental Medicine, University of Porto (FMDUP), is a national leading school centered on the education of Dental Medicine, being responsible for undergraduate education, as well as for several Master and Doctoral degrees and Continuous Education programs. Besides the social commitment with the primary and secondary healthcare regarding oral health, it is a center of excellence regarding biomedical research. In this regard, FMDUP has long term expertise on tissue,

medical devices. Current scientific advances result from cross departmental programs and multidisciplinary collaborations embracing basic and clinical sciences.

Biocompatibility and *in vitro* tests

Abstract

Bone is a highly vascularized tissue, which is constantly being remodelled by the coordinated action of bone-resorbing osteoclasts and bone-synthesizing osteoblasts, in order to maintain its biological and mechanical integrity. Interaction of a biomaterial with the bone tissue involves complex cellular events, leading to an appropriate osseointegration/regeneration process. Recruitment of osteoblastic lineage cells, adhesion to the material surface, and their proliferation and differentiation ensure the initial bone formation events. An active remodeling process certifies the long-lasting bone integrity and stability. An adequate microvascularization is necessary for the successful outcome of this bone dynamics. This talk gives an overview on representative *in vitro* models to address the cellular events in the bone microenvironment, i.e. cultures of (i) osteoblastic cells, (ii) osteoclastic cells (iii) endothelial cells and, also, co-cultures of (iv) osteoblastic and osteoclastic cells and (v) endothelial and osteoblastic cells, to provide integrated information on the bone/biomaterial interactions at a cellular and molecular level.

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Corrado PICONI	
Professor, Applied Physics Catholic University, Orthopedics Dept., Rome, Italy. Senior Fellow, Center for Study of New Materials and Prosthetic Technologies Tor Vergata University, Rome, Italy.	
Corpico@libero.it +39 334 622 1614	

After his studies in Roma he joined the Ceramics Technology Laboratory of the National Committee for Nuclear Energy (now ENEA), where he carried out studies on the thermophysical properties of Uranium and Plutonium oxides used as nuclear fuels (thermal diffusivity, thermal expansion). In close cooperation with the laboratories of the Commissariat à l'Energie Atomique (CEA) and of AGIP Nucleare S.p.A. - the in-pile mechanical characterization of ceramic fuels for Thermal and Fast Breeder Reactors in normal and in off-normal conditions. In 1989, due to moratorium in nuclear energy activities in Italy, he transferred the know how and technologies of his research group to the development of ceramics for clinical applications, with special emphasis on zirconia. From the year 2000 to 2005 he was as R&D Project Manager in Tecnobiomedica S.p.A working on the development of medical devices for orthopedic and cardiovascular applications. From 2005 to 2014 he was Scientific Director of the MeLab R&D facility of GHIMAS S.p.A. (Brindisi, Italy), working on ceramic and polymeric scaffolds for bone tissue engineering. In 1997 he was appointed as Lecturer in Biomaterials by the School of Orthopedics, Faculty of Medicine of the Catholic University in Rome, where he currently teaching as Professor in Applied Physics. He is also Research Fellow in the Centre for New Materials for Prosthetic Technologies, in the University of Tor Vergata, Roma, Italy.

The Department of Orthopedics of the Catholic University in Rome is one of the centers of excellence for this kind of surgery. It has been since a long while involved in research for the development of biomaterials, especially in the framework of EU-funded projects, in close cooperations with Academic and Industry.

Title of the lecture: On the history of bio-ceramics for hip joint replacement

The lecture traces the development of oxide ceramics in a historical perspective, with special attention to the continuous ceramists' efforts focused both on the reduction of the size of the defects, both in enhancing the intrinsic toughness of the material. This led to the HIP-treated, high-density clinical alumina and to the development of transformation toughened ceramics, especially YTZP and Mg-PSZ during the mid-1980s and to the alumina-zirconia composites that are today the standard ceramic in hip joint replacements.

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CHEVALIER Jérôme

Professor
MATERIALS SCIENCE DEPARTMENT (MATEIS), INSA-LYON

Jerome.chevalier@insa-lyon.fr
+ 33 4 72 43 61 25

Short biography

Born in 1970, Jérôme Chevalier is currently full Professor at the National Institute of Applied Sciences, in France. After receiving his phD in 1996 (Mechanical properties of biomedical grade zirconia), Jérôme Chevalier first became Ceramic Engineer in Saint Gobain Group. In 1997, he joined the National Institute of Applied Sciences, in Villeurbanne. He is currently Director of the Materials Science Laboratory MATEIS (180 persons). He is member of the 'Institut Universitaire de France', and editor of the Journal of the European Ceramic Society. He is recognized for his work on the fatigue behavior of ceramics and on the aging process in zirconia based ceramics and composites. He is leading the European project LONGLIFE on zirconia for dental and orthopedic applications. He has published more than 160 papers and holds 10 patents.

Short institution presentation

Located on the premises of the Science and Technological Park of la Doua in Villeurbanne, INSA Lyon graduates over 950 engineers each year in 12 fields of specialization. MATEIS (for Materials, Engineering and Science) is one of the 21 laboratories of INSA. Mainly dedicated to Structural and multi-functional materials, MATEIS involves physics, chemistry and mechanics of Materials. The main (systemic) approach of the laboratory is to understand the relations between process and microstructures generated, then between microstructure or architecture and (physical / chemical / mechanical) properties in relevant conditions.

The answer of bioceramics to long-term mechanical demands

Abstract

High-tech ceramics are used today as femoral heads and acetabular cups for total hip replacement, dental implants and restorations, bone fillers and scaffolds for tissue engineering. In addition to biological requirements, ceramic – based implants must meet high mechanical demands. This is for example the case of hip joints or dental implants, for which high strength and toughness are needed. We will show how it is possible to design complex microstructures with a combination of reinforcement mechanisms. Bone substitutes are generally designed to optimize their integration in bone and to favor bone healing and growth. However, at different stages of their use, they are submitted to significant loads. Current strategies therefore aim at developing substitutes with sufficient mechanical properties. Complex architectures including inorganic and organic phases offer today some toughening that can be observed in natural tissues.

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

Valter SERGO

Full Professor, Science of Materials
Engineering and Architecture Dept., University of Trieste – ITALY-

sergo@units.it
+39 040 5583702

Short biography

- University Degree (Laurea) in Chemistry, University of Trieste, (Final grading 110/110), 1985.
- Master of Science in Ceramic Engineering, Ohio State University (USA), 1989.
- Ph. D. in Materials Engineering, Italian Ministry of University and Research, 1989.
- Research associate , University of California at Santa Barbara (USA)(1993).
- Research associate , Kyoto Institute of Technology, Kyoto (Japan) (1995 and 1996)
- Associate Professor, University "La Sapienza" of Rome (Italy) (1998-2001)
- Visiting professor at the Technical University of Dresden, Germany (2001).

The scientific activity of Prof. Sergo has been mainly devoted to the study of spectroscopic methods for the characterization of advanced ceramic materials for structural and functional applications. The main research areas have been the following:

-) Use of optical spectroscopies for the determination of phases and stresses in ceramic materials.
-) development of oxides for biomedical applications.

He has published over 100 technical papers, mostly regarding spectroscopy of ceramic materials. He has an H-index of 28 (Scopus+WOS+Google Scholar). He has presented over 50 invited lectures both at scientific meeting and institutions and at industrial companies worldwide.

He ist the president of the scientific Advisory board oft he EU project LONGLIFE and the Working Group leader oft he COST action RAMAN4CLINICS, for the use of spectroscopy in medical pratice.

Short institution presentation

The Raman spectroscopy lab at the University of Trieste is the most important lab in Italy devoted to the use of spectroscopy for the development/characterization of new inorganic biomaterials, for use of new techniques based on Raman for Therapeutic Drug Monitoring and for medical diagnostic applications

Title of the lecture: Spectroscopic analyses for the characterization of bioceramics

Abstract

Raman and fluorescence spectroscopy will be presented as fundamental tools for studying the phase composition and the stress in ceramic biomaterials. Specifically, fundamentals, characterization and case hystories of hydroxyapatite, zirconia and alumina will be presented, in the context of biomaterials applications.

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

Name Surname: Meinhard Kuntz

Position: Manager Oxide Development, Service Center Development
Institute / Department: CeramTec GmbH, Plochingen, Germany

mail: m.kuntz@ceramtec.de
Telephone +49 172 6204 737

Short biography : Study: Mechanical Engingeering, University of Karlsruhe. PhD Thesis 1993: “Crack Resistance of ceramic matrix composites”. Assistant professor at University of Bremen 1994 – 2005, powder processing, sintering, fracture mechanics, micromechanics, ceramic matrix composites. Since 2005 CeramTec GmbH, responsible for oxide development incl. processing technology bioceramics (alumina, zirconia, ZTA)

Short institution presentation
CeramTec: World leading company for ceramics in hip / knee arthroplasty. Also a leading company for cutting tools, mechanical applications, piezo ceramics, electronic applications et al.

Title of the lecture: Processing – the industry point of view

Abstract:
Processing technology: raw material selection, powder processing, shaping, sintering, hard machining, quality control
Techniques for continuous process control and development
Relation of composition – processing –material and product properties
Challenges for future applications

Name Surname: Maria-Pau Ginebra

Position: Full Professor
Institute / Department: Dept. Materials Science and Metallurgy, Technical University of Catalonia (UPC), Barcelona, Spain

mail: maria.pau.ginebra@upc.edu
Telephone: +34 934017706

Short biography

She leads the Biomaterials, Biomechanics and Tissue Engineering Group (BBT) of UPC. Her research interests include the design and development of new biomaterials for bone regeneration, bone tissue engineering and drug delivery. Her research team has made significant contributions in the processing and characterisation of a new generation of low-temperature calcium phosphates which mimic bone extracellular matrix, including calcium phosphate cements and foams, incorporating synthetic or natural polymers, and/or biologically active molecules. She is involved also in new biofabrication strategies, including injectable scaffolds for bone tissue engineering, bioinspired substrates and 3D printing of regenerative medical implants. She is author of more than 145 articles in peer-reviewed International journals as well as of 9 patents. In 2013 she founded the spin-off company Subtilis Biomaterials. She has received numerous awards, amongst them the Narcis Monutriol Medal in 2012 and the Racquel LeGeros Award, for her contribution to calcium phosphate research, in 2013.

Short institution presentation

The BBT Group focuses its activities in the design, development, functionalization and characterization of new biomaterials for tissue regeneration and functional repair, with special attention to bone regeneration applications. The BBT's work is intrinsically interdisciplinary, creating a direct link between two different fields, materials science and biomedicine. The translation of the results to industrial partners in the biomedical sector is a driving force for BBT.

Title of the lecture: Calcium phosphate ceramics

Abstract Large bone defects pose a great clinical and socioeconomic challenge. In these situations it is necessary to induce bone formation beyond the capacity of the host tissue. The development of synthetic materials is a promising strategy that overcomes some limitations associated with bone autografts or allografts. Mimicking the extracellular matrix of bone tissue is a good approach, which has led to the development of a wide range of calcium phosphates that are used in the clinic, from high-temperature sintered calcium phosphates to biomimetic nanoapatites. An overview of these bioceramics and their applications will be given in this lecture.

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

Stuart Hampshire

Professor Emeritus
Materials and Surface Science Institute
University of Limerick
Ireland

stuart.hampshire@ul.ie
Telephone: +353 61 202640

Short biography

Professor Hampshire received his PhD in Engineering Ceramics from the University of Newcastle-upon-Tyne in 1977 and then made Post-doctoral Research on SiAlON Glasses from 1978 to 1980. Starting in the early 1980s, Professor Hampshire developed a Research Centre at UL in Ceramics and Glasses which has been involved in European and international collaborative research projects in the field of special ceramics and glasses. He has been a visiting scientist at the Universities of Rennes and Limoges, France, at the University of Karlsruhe, Germany and at the National Industrial Research Institute, Nagoya, Japan. Professor Hampshire was a founder member of the Materials and Surface Science Institute at the University and coordinator of successful applications for funding totalling €16 million from the Irish government to establish the first phase of the Institute at the University of Limerick. The Institute currently houses 200 scientists and engineers engaged in research in (i) nanomaterials (ii) composite, glass and ceramic materials (iii) biomedical materials and engineering and (iv) bio/catalysis and clean technology. Professor Hampshire's Research Publications include: 9 books/proceedings volumes, 5 commissioned chapters in text books, 130 journal articles and 50 invited talks at international meetings.

Short institution presentation

The Materials & Surface Science Institute of the University of Limerick, established in 1998, is a centre of excellence generating state-of-the-art fundamental research on topics of industrial significance in the fields of surface science and materials. The Institute houses a multidisciplinary team of scientists (chemistry, materials science, physics and biochemistry) and engineers (mechanical, aeronautical, biomedical, manufacturing and electronic) who undertake research in the design, synthesis, processing, characterisation and modelling of materials. MSSI expertise covers the full range of materials, supported by state of the art infrastructure and facilities. MSSI priority research themes are Biomedical Engineering & Biomaterials; Composite Materials; Pharmaceutical Materials and Materials for Energy & Environment. MSSI research focuses on applications in Health, Transport, Energy and Clean Technology.

Title of the lecture : **Bio-glasses and glass-ceramics**

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

Eamonn de Barra	
Position: Lecturer Biomaterials Institute / Department: University of Limerick, Center for Applied Biomedical Engineering Research / Department of Mechanical, Aeronautical and Biomedical Engineering	
e-mail: eamonn.debarra@ul.ie Telephone: +35361202942	

Short biography

Eamonn teaches undergraduate and graduate classes on Biomaterials for medical device applications. His research interests include studies of the structure, properties and applications of reactive/degradable glasses and ceramics, bioactive composites and tissue adhesives and cements, mainly for orthopaedic and dental applications. He has developed and commercialized more than ten novel implant materials in collaboration with various medical device manufacturing organizations. He is currently leading several commercial development projects on osteo-conductive bone substitutes, drug eluting bone cements and substitutes and composite bone adhesives.

Short institution presentation

The Centre for Applied Biomedical Engineering Research (CABER) is a University of Limerick designated research centre based in the Materials and Surface Science Institute (MSSI). The mission is to develop new medical device technology which will enhance patient care and lead to improved patient outcomes in the areas of Orthopaedic Biomechanics, Biomaterials design and characterisation, Cardiovascular systems and medical device design.

Title of the lecture: **Bone Cements and Substitutes – the Advantages and Limitations of Ceramics**

Abstract:

Fixation of bone and of orthopaedic devices and bone substitution present many challenges to the materials scientist. The scope of fixation and substitution strategies will be discussed and those materials currently approved for clinical use will be critically reviewed. The deficiencies of current materials will be discussed in terms of the relationships between material properties and their clinical performance, as well as the consequent implications for areas of future development. The potential of ceramic and/glass based materials will be discussed in this context.

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

Name Surname: LERICHE Anne

Position: Professor
Institute / Department: University of Valenciennes – LMCPA –
Pôle Universitaire de Maubeuge
Boulevard Charles de Gaulle
59600 Maubeuge - France

mail: anne.leriche@univ-valenciennes.fr
Telephone: +33327531666

Short biography

Anne Leriche was born in Belgium in 1959. She got a M. Sc. in Chemistry in 1981 and the Doctorate of Sciences in 1986, both with honors from the State University of Mons (Belgium). She obtained the diploma "Habilitation to supervise researches" in 1992 from the University of Valenciennes (France). She got a grant to start her doctorate thesis from IRSIA (1981-1983), became successively researcher at the Belgian Ceramic Research Centre in Mons (1983-1989), R&D head of Neoceram SA (1989-1990). In 1990, Anne Leriche joined the LMCPA at the University of Valenciennes. She has been Lecturer from 1991 to September 1994, then reader and finally full Professor in 2006. She has been Director of the laboratory since September 1999. During her career, she supervised 15 theses, participated to several European projects and published 80 papers. She is currently President of the French Ceramic Society, of the European Ceramic Society, member of the Belgium Ceramic Society board. She has been elected to the International Academy of Ceramics in 2012.

Short institution presentation : The LMCPA (Laboratoire des Matériaux Céramiques et Procédés Associés) includes about 30 researchers working on processing and characterization of ceramics.
The research activities are focused on three topics:
Bioactive ceramics for bone substitution and drug delivery systems: calcium phosphate powder synthesis, macroporous bone substitute fabrication, functionalization for prophylactic treatments and phagotherapy.
Functional ceramics and composites: fabrication of piezoelectric ceramics and polymer-ceramic composites from powder synthesis up to devices for actuators.
Surface functionalization by ceramic coatings: wear, corrosion and temperature resistant coatings by sol-gel technique.

Title of the lecture: **3D - Processing of bioceramic scaffolds: state of the art and current trends** -

Abstract : Macroporous ceramic scaffolds can be performed through different processing routes such as foam, adding of porogen substances, slurry ice-templating, additive manufacturing such as robocasting, stereo-lithography… which lead to specific macro- and micro- porosities. The lecture will be devoted to the description of these techniques and the comparison of the as-obtained porous structures.

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

Yannis Missirlis	
Professor (ret'd) Lab. of Biomechanics & Biomedical Engineering	
misirlis@mech.upatras.gr Telephone : +302610969460	

Short biography

Studied at National Technical University of Athens, Greece (Diplome), Syracuse University, USA (M.Sc.), Rice University, USA (Ph.D.) Chemical Engineering. Assistant and Associate Professor of Biomedical Engineering, McMaster University, Canada (1974-1980) and since 1981, full professor of Biomechanics, University of Patras, Greece. Established the first Laboratory of Biomechanics and Biomedical Engineering (Director 1981-2013) in Greece.

Short institution presentation

Within University of Patras, in the Faculty of Engineering, in the Dept. of Mechanical Engineering & Aeronautics, the Laboratory of Biomechanics & Biomedical Engineering is carrying research in Tissue and Cell Biomechanics, in Biomaterial - Cell Interactions, in Tissue Engineering, and in Biomaterials Characterization.

Title of the lecture **: Modular Bioreactors for appropriate Tissue Engineering**

Abstract

A review of the emergence of a variety of bioreactors used in Tissue Engineering will be presented. The importance of mechanical signaling transmitted through the operation of bioreactors to the cells cultivated within scaffolds in the bioreactor will be analyzed. Bioreactors for both soft and hard tissues will be shown from the concept to the operational principles.

Jan Willem Hoekstra

Dentist-Implantologist, Assistant Professor
Radboud university medical center, department of Biomaterials

JanWillem.Hoekstra@Radboudumc.nl
+31(0)243667305

Short biography

Dr. Jan Willem Hoekstra started to study Dentistry in 2000 at the Radboud University Medical Center in Nijmegen, the Netherlands. In 2005 he graduated from Dentistry and started to work in general dental practices. Meanwhile, dr. Hoekstra followed a 1,5 year course in General Medicine at the University Medical Center in Utrecht, the Netherlands.
In 2007 dr. Hoekstra started his PhD project at the Department of Biomaterials of the Radboudumc on calcium phosphate based materials for bone regeneration. Meanwhile, he was trained as an Oral Implantologist by prof. dr. G.J. Meijer. In 2013 he successfully finished his PhD project with a thesis entitled 'Calcium Phosphate Based Materials for Bone Regeneration: Preclinical and Clinical Aspects of In Vivo Application Prior to Implant Dentistry'.
At this moment, dr. Hoekstra works full-time at the Radboudumc as a clinician in the 'Center for Special Dental Care' (congenital dental disorders, severe prosthetic problems and maxillofacial cancer patients) and the 'Center for Complex Dental Care' (oral implantology). Furthermore, he works as a clinical teacher for Dentistry students (department of Prosthetics). Finally, dr. Hoekstra works as a preclinical and clinical researcher (Assistant Professor) at the Department of Biomaterials, where he focuses on bone substitution and implant material development.

Short institution presentation

The Radboudumc is a large university medical clinic in Nijmegen, the Netherlands. Within the Radboudumc, the department of Dentistry is divided in several sub-departments. The department of Biomaterials is one of the major research departments within Dentistry. The faculty consists of one professor, one associate professor, six assistant professors and roughly 25 PhD students. Main research topics are bone substitute materials, implant surface modifications, periodontal regeneration and stem cell research.
Further, numerous clinical sub-departments are present in the Dentistry department that treat patients and teach dental students.

Clinical application of bone substitute materials in dentistry: how, what, when, where?

Abstract

Many of us perform research on biomaterials in general and bone substitutes in more detail. In the end, the goal of tissue engineering research is to make it applicable to the clinical situation so that the patient benefits from our research. In this lecture, clinical problems that can be treated by a bone substitute material will be presented. Further, examples will be given of the need and use of bone substitute materials.

Organizing Committee

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY,
APPLICATION TO BIOCERAMICS & BIOGLASSES

Organizational Committee

- **Dr Francis Cambier** ECerS secretariat, chair of Cost Action MP1301 "Newgen" - Belgium
- **Prof Jérôme Chevalier** Leader F7 project "LongLife" - France
- **Prof. Anne Leriche**, University of Valenciennes -LMCPA - France
- **Dr. Stéphane Hocquet** and **Véronique Huart,** Belgian Ceramic Research Centre- Belgium
- **Dr. María Jesús Pascual** and **Dr. Carmen Baudín,** Instituto de Cerámica y Vidrio, CSIC - Spain

CAMBIER Francis	
DIRECTOR BELGIAN CERAMIC RESEARCH CENTRE, Mons, Belgium	
f.cambier@bcrc.be + 32 65 40 34 21	

Short biography

Born in Belgium in 1949, Francis Cambier is currently Drector General of the Belgium Ceramic Research Centre (about 100 employees). He received his academic degree in 1971 and achieved his doctorate thesis in 1978 both in industrial chemistry. He joined the BCRC in 1979 to perform research in traditional ceramics and moved to technical ceramics the year after to become rapidly team leader in a research group on bioglasses. In November 1984, he was appointed Research Manager of the Centre, occupying this position till 1996 when he became head of the BCRC. From 1991 to 2004, he took some education duties at the University of Valenciennes (France) and from 2001 to 2014, he was in charge of lectures on advanced ceramics including biomedical applications at the University of Mons. As DG of the BCRC, Dr Cambier is involved in the management boards of several companies and associations and he has received several distinctions in Belgium. He is also very active in many ceramic societies: member of the American Society, of the French Group of Ceramics, elected at the International Academy of Ceramics, treasurer and past president of the Belgian Ceramic Society, secretary of the JECS Trust, secretary and fellow (2013) of the European Ceramic Society, receiving the Stuijts award from this last society in 2008. Dr Cambier is also member of various scientific advisory boards and act as referee for several scientific journals. He has published more than 200 papers and given more than 250 communications (+ 50 as KN or invited). The last developments concern mainly the processing of hydroxyapatite and TCP scaffolds and their behaviour in vitro. Since 2013, Dr F. Cambier is chair of the Cost Action MP 1301: Newgen (New Generation Biomimetic Implants for Bone Engineering).

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

CHEVALIER Jérôme	
Professor MATERIALS SCIENCE DEPARTMENT (MATEIS), INSA-LYON	
Jerome.chevalier@insa-lyon.fr + 33 4 72 43 61 25	

Short biography

Born in 1970, Jérôme Chevalier is currently full Professor at the National Institute of Applied Sciences, in France. After receiving his PhD in 1996 (Mechanical properties of biomedical grade zirconia), Jérôme Chevalier first became Ceramic Engineer in Saint Gobain Group. In 1997, he joined the National Institute of Applied Sciences, in Villeurbanne. He is currently Director of the Materials Science Laboratory MATEIS (180 persons). He is member of the 'Institut Universitaire de France', and editor of the Journal of the European Ceramic Society. He is recognized for his work on the fatigue behavior of ceramics and on the aging process in zirconia based ceramics and composites. He is leading the European project LONGLIFE on zirconia for dental and orthopedic applications. He has published more than 160 papers and holds 10 patents.

LERICHE Anne	
PROFESSOR University of Valenciennes -LMCPA - France	
anne.leriche@univ-valenciennes.fr Telephone: +33327531666	

Short biography

Anne Leriche was born in Belgium in 1959. She got a M. Sc. in Chemistry in 1981 and the Doctorate of Sciences in 1986, both with honors from the State University of Mons (Belgium). She obtained the diploma "Habilitation to supervise researches" in 1992 from the University of Valenciennes (France). She got a grant to start her doctorate thesis from IRSIA (1981-1983), became successively researcher at the Belgian Ceramic Research Centre in Mons (1983-1989), R&D head of Neoceram SA (1989-1990). In 1990, Anne Leriche joined the LMCPA at the University of Valenciennes. She has been Lecturer from 1991 to September 1994, then reader and finally full Professor in 2006. She has been Director of the laboratory since September 1999. During her career, she supervised 15 theses, participated to several European projects and published 80 papers. She is currently President of the French Ceramic Society, of the European Ceramic Society, member of the Belgium Ceramic Society board. She has been elected to the International Academy of Ceramics in 2012.

HOCQUET Stéphane	
RESEARCHER BELGIAN CERAMIC RESEARCH CENTRE, Mons, Belgium	
s.hocquet@bcrc.be + 32 65 40 34 78	

Short biography

Dr. Stephane Hocquet is Doctor in Chemistry (physicochemistry of polymers) since 2002 and joined the CRIBC in July 2003 to work in the field of inorganic materials. He has participated in the writing and the management of a large panel of applied research projects dedicated to traditional and advanced ceramics. His involvement in biomaterials has led to the creation of the NEWGEN network (in the framework of COST Action MP1301) gathering 150 European institutions, including academics, independent R&D centers, industrials and medical groups. He is Management Committee member and Short Term Scientific Mission coordinator of the COST Action NEWGEN.

HUART Véronique	
SECRETARY BELGIAN CERAMIC RESEARCH CENTRE, Mons, Belgium	
v.huart@bcrc.be + 32 65 40 34 21	

Short biography

Born in 1981 in Belgium, Véronique Huart is the secretary of Dr. Francis Cambier, Director of the Belgian Ceramic Research Centre, since 2003 and, as so, managed the secretariat of the Belgian Ceramic Society, the European Ceramic Society and of the JECS Trust. She is also Grant Holder Manager of the COST MP1301 Newgen (New Generation Biomimetic Implants for Bone Engineering) Project.

SUMMER SCHOOL

CERAMIC & GLASS SCIENCE & TECHNOLOGY, APPLICATION TO BIOCERAMICS & BIOGLASSES

JESÚS PASCUAL María	
RESEARCHER INSTITUTO DE CERÁMICA Y VIDRIO, CSIC - Spain	
mpascual@icv.csic.es +34 91 735 5840	

Short biography

Dr. María Jesús Pascual**,** Doctor in Chemistry (2000) from Autónoma University of Madrid (UAM), Spain. Tenured Scientist in the ICV (CSIC) and member of the Glass Department since 2007. She has participated in 14 national projects, 7 international projects and 11 cooperation projects and integrated actions. She has supervised several Masters and PhD theses in the field of glasses and glass-ceramics and is co-author of more than 70 SCI papers. Secretary of the Glass Section of the SECV (Spanish Society of Ceramic and Glass) since 2008. Gottardi Prize in 2010 (given by the International Commission on Glass).

BAUDIN Carmen	
RESEARCHER INSTITUTO DE CERÁMICA Y VIDRIO, CSIC - Spain	
cbaudin@icv.csic.es +34 91 735 5840	

Short biography

Staff researcher at Instituto de Cerámica y Vidrio, CSIC, (Ceramics and Glass Institute, ICV, CSIC) since 1989. Coming from the field of structural ceramics, advanced and traditional, she works on biomaterials in 2008. Nowadays she is the coordinator of one of the four working groups the Cost Action MP 1301: Newgen (New Generation Biomimetic Implants for Bone Engineering).

Her most significant research contribution is in the field of relationships between microstructure and mechanical behavior of ceramics. She is co-author of more than 200 scientific papers and has presented more than 150 conference papers (22 invited). Additionally to her research work, she is professor in different masters of Spanish and Latin -American universities and is supervisor and examiner of PhD thesis for different universities in Spain, Europe and Latin-America.

Since 2012 she is General Secretary of the Spanish Ceramics and Glass Society and Editor of Boletín de la Sociedad Española de Cerámica y Vidrio (Journal of the Spanish Ceramics and Glass Society). She is treasurer and fellow of the European Ceramic Society (ECERS) and treasurer of the Journal of the European Ceramic Society Trust.