AVVISO SEMINARI BIOMATERIALI

Nell'ambito del progetto '*Visiting Scientist - Excellent Science*' il Dipartimento di Scienze Chimiche e Geologiche ospita la Prof. Maria Vallet-Regì (Departamento de Quimica Inorganica y Bioinorganica, Universidad Complutense de Madrid), leader mondiale nel campo dei biomateriali e nanomedicina, in particolare 'stimuli-responsive drug delivery' and 'tissue engineering' (with reference to ageing).

I Seminari si svolgeranno in Aula 102 (sopra Biblioteca Biomedica) secondo il seguente Calendario:

1. Biomaterials Design - giovedi 10 novembre ore 16,
2. Smart Nanosystems - mercoledi 16 novembre ore 16.

La Prof.Vallet Regi ha preparato dei test per dottorandi e laureandi per il riconoscimento di CFR.

Di seguito gli *abstract* degli argomenti trattati:

BIOMATERIALS DESING

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The use of biomaterials in patients requiring repair or regenerate parts of their body is a subject of great interest because of the solutions that can provide for a better quality of life. However, technical issues and biological materials or cells are remarkable and, before applying those biomaterials to patients, preclinical models should be analyzed to solve the limitations of cell viability, mechanical strength (from the moment they are introduced into the body until they are replaced by new tissue), and also the biological adaptation in the organism. Both the manuf**act**ure of spare parts for the human body, by traditional methods or using tissue engineering or cell therapy, and the design of nanoparticles for devices to achieve a release of highly toxic drugs specifically targeted to tumors, are currently challenges of great importance in biomedical research. The incessant progress in the preparation of nanosystems with applications in the medical field has led to new challenges in the design of smart materials able to meet clinical requirements. Research on bioceramics has evolved from the use of inert materials for mere substitution of living tissues towards the development of third generation bioceramics aimed at inducing bone tissue regeneration. Bioceramics have remarkable features resulting from the synergistic combination of both inorganic and organic components that make them suitable for a wide range of medical applications.
Certain bioceramics, such as ordered mesoporous silicas can exhibit different kind of interaction with organic molecules to develop different functions. The weak interaction of these host matrices with drug molecules confined into the mesoporous channels allows these hybrid systems to be used as controlled delivery devices. Moreover, mesoporous silicas can be used to fabricate three (3D)-dimensional scaffolds for bone tissue engineering. In this last case, different osteoinductive agents (peptides, hormones and growth factors) should be strongly grafted to the bioceramic matrix to act as attracting signals for bone cells to promote bone regeneration process.

M Vallet-Regí and E. Ruiz-Hernández. BIOCERAMICS: FROM BONE REGENERATION TO CANCER NANOMEDICINE. Adv. Mater. 23, 5177–5218. (2011)

M. Vallet-Regí, M. Colilla and B. González. MEDICAL APPLICATIONS OF ORGANIC-INORGANIC HYBRID MATERIALS WITHIN THE FIELD OF SILICA-BASED BIOCERAMICS. Chem. Soc. Rev. 70, 596-607 (2011)
E. Ruiz-Hernández, A. Baeza, M. Vallet-Regí. SMART DRUG DELIVERY THROUGH DNA/MAGNETIC NANOPARTICLE GATES. ACS Nano. 5 (2), 1259–1266 (2011).
M. Vallet-Regí, E. Ruiz-Hernández, B. González, A. Baeza. DESIGN OF SMART NANOMATERIALS FOR DRUG AND GENE DELIVERY. J. Biomater. Tissue. Eng. 1, 6-29 (2011).
J. Simchenn, A. Baeza, D. Ruiz, M. Esplandiu, M. Vallet-Regí. ASYMMETRIC HYBRID SILICA NANOMOTORS FOR CAPTURE AND CARGO TRANSPORT: TOWARDS A NOVEL MOTION-BASED DNA SENSOR. Small. 8(13), 2053-2059 (2012).
M. Vallet-Regí, International Scholarly Research Network ISRN Materials Science, Volume 2012, Article ID 608548, 20 pages, doi:10.5402/2012/608548
A. Baeza, E. Guisasola, E. Ruiz-Hernández and M. Vallet-Regí. MAGNETICALLY TRIGGERED MULTI-DRUG RELEASE BY HYBRID MESOPOROUS SILICA NANOPARTICLES. Chem. Mater. 24, 517-524 (2012).
M.Vallet-Regí, M. Manzano, M. Colilla. Biomedical Applications of Mesoporous Ceramics: Drug delivery, Smart Materials and Bone Tissue Engineering. CRC Press. 2013.
M. Vallet-Regí, F. Balas, D. Arcos. Angew. Chem. Int. Ed. **2007**, 46, 7548-7558.
M. Vallet-Regi. J. Internal Medicine. **2010**, 267, 22-43.
M. Vallet-Regí, M. Manzano, J.M. González-Calbet and E. Okunishid. Chem. Commun. **2010**, 46, 2956 – 2958.

Smart nanosystems

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This lecture will describe the production of smart nanosystems capable of: (1) carrying antitumor agents selectively to a tumor tissue, and (2) releasing them there thanks to the application of an external stimulus. We use the term *smart* because those nanocarriers are able to release the drugs when and where they are needed. The surface of our nanosystems can be decorated with molecules able to recognize specifically tumor cells and to trigger the penetration of nanocarriers into them, like a Trojan horse. The main advantage of developing selective nanocarriers able to accumulate only in tumor tissues are: (1) increased selectivity of the therapy, which allows reducing the cytotoxic dosage; (2) higher control over the administered doses; and (3) the reduction of side effects, because the drugs will not be distributed throughout the whole body. Taking into account that most anticancer drugs are cytotoxic, their release must take place only inside tumor cells. This can be achieved using Chemistry, which provides the necessary tools to prepare stimuli-responsive nanocarriers in which the release of the drug can be controlled and triggered from the outside. In this talk the different stimuli (4) which we are using in our research group will be described.

Keywords: nanomedicine, drug carriers, stimuli –responsive system, Smart nanosystems.

References

[1] E. Ruiz. A. Baeza. M. Vallet-Regí. *ACS Nano* **2011**, *5(2)* 1259-1266
[2] A. Baeza, E. Guisasola, E. Ruiz, M. Vallet-Regí, *Chem. Mater.*, **2012**, *24*, 517-524.
[3] A. Baeza, E. Guisasola, A. Torres-Pardo, J.M. González-Calbet, G.J. Melen, M. Ramirez, M. Vallet-Regí. *Adv. Func. Mater.*, **2014**, *24*, 4625–4633.
[4] J.L. Paris, V. Cabañas, M. Manzano, and M. Vallet-Regí, *ACS Nano*, **2015**, *9(11)*, 11023-11033.