Research lines in Hyperthermia at the Bioinstrumentation Laboratory of the Centre for Biomedical Technology

J.J. Serrano 1,2, A. Mina1,2, C. Sánchez1,2, L.E. Hernández5,6, N. Félix1,2, T. Fernández1,2,4, J. Crespo1,2, V. Ferro1,2, R.A. García 1,2, L. Urbano1, E. Aznárez3, R. Martínez3, L. Hernández1,2, E. Arroyo1,2, M. Ramos1,2,4, F. del Pozo1,2

1 Biomedical Engineering and Telemedicine Centre (GBT), Centre for Biomedical Technology (CTB), Technical University of Madrid (UPM), Madrid, Spain.
2 Biomedical Research Networking Center in Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Zaragoza, Spain.
3 Institute of Molecular Recognition and Technological Development (IDM), Universidad Politécnica de Valencia (UPV), Valencia, Spain.
4 Centre for Molecular Biology “Severo Ochoa” (CBMSO), Universidad Autónoma de Madrid (UAM), Madrid, Spain.
5MRI-DT, S.A de C.V., Mexico. 6TEC de Monterrey, Mexico.

Introduction

The Bioinstrumentation Laboratory belongs to the Centre for Biomedical Technology (CTB) of the Technical University of Madrid and its main objective is to provide the scientific community with devices and techniques for the characterization of micro and nanostructures and consequently finding their best biomedical applications.

Specifically, the aim of the hyperthermia methods used in The Bioinstrumentation Laboratory is the development of thermal therapies, some of these using different kinds of nanoparticles, to kill cancer cells and reduce the damage on healthy tissues.

Magnetic Hyperthermia

The Magnetic hyperthermia use the effect produced by irradiation of alternating magnetic field in magnetic fluids, in order to study the thermal behavior of the magnetic nanoparticles (MNPs). The working frequency range of our device is 9KHz-2MHz.

Properties

- Behavior of the MNPs embedded in different viscous medium, example: Water, Agar.
- Study of samples with different concentrations of MPNs.
- Equipment Optimization, in order to provide the best performance possible.
- Characterization of temperature change using different excitation signals.

Optical Hyperthermia

The Surface Plasmon Resonance (SPR) in gold nanoparticles exposed to a laser light, results in a strong enhancement of light absorption. Furthermore, gold nanoparticles convert the absorbed light into localized heat quickly. These properties allows the development of hyperthermia therapies for cancer treatment.

Results

These curves show that a higher power of the laser source produces more plasmonic excitation and consequently, a higher temperature is reached. Temperature curves using different configurations of the hyperthermia device are essential to develop a thermal model.

MRI Hyperthermia

The Bioinstrumentation Laboratory in collaboration with the Mexican company MRI-DT have recently implemented a new research line on Nuclear Magnetic Resonance Hyperthermia, which is sustained on patent US 7,423,428B2 owned by this company and developed by Eng. Lázaro Eusebio Hernández Pérez. This investigation is based on the use of clinical MRI equipment not only for diagnosis but for therapy. We thanks to Mr. Javier Núñez Peláez for sponsoring the project.

Properties

- Differentiation in temperature increments in diverse samples by RF absorption and NMR effect.
- Differentiation in Nuclear Magnetic Resonant frequency between healthy and cancer cells; and other biomolecular targets.
- Pulse sequence design to produce heating and cooling in biological samples.

Contact

José Javier Serrano Olmedo
siserran@etsit.upm.es
Bioinstrumentation Laboratory
Hyperthermia Unit
Centre for Biomedical Technology (CTB)
Parque Científico y Tecnológico de la UPM
28223 Pozuelo de Alarcón, Madrid, España
Phone: +34 91 452 49 00 (ext: 1769)