2022 - Activity Report Summary PCE 20

In this stage, we designed and produced a laboratory installation that allows the application of a rotating magnetic field in a wide range of frequencies and field intensities on a set of cell culture wells, with normal or cancer cells and particles or nanowires added to the cell culture media. The installation ensures all the conditions for carrying out the experiments planned in this project. In vitro biocompatibility of Fe-(Cr/Mn/Ti)-Nb-B particles, as well as Ni, Co, Ni-Fe and Co-Fe nanowires was tested on osteosarcoma cells (OS), adipose derived stem cells (ADSC) and fibroblasts (FB) using different concentrations of nanoparticles/nanowires. The nanomaterials proved to be biocompatible in vitro. We also tested the viability of OS, ADSC and FB after magnetomechanical actuation of of Fe-(Cr/Mn/Ti)-Nb-B particles, as well as Ni, Co, Ni-Fe and Co-Fe nanowires using different nanoparticle/nanowire concentrations, and found that they can be used to destroy cancer cells through magnetomechanical actuation without harming healthy cells. Complex tests through high-resolution SEM and TEM microscopy highlighted the presence of magnetic particles and nanowires on the surface but also inside the considered cells. Based on the tests performed, it was possible to appreciate that the process of destruction of cells in a rotating magnetic field takes place both through direct magnetomechanical actuation and through the initiation of the apoptosis process.

Several articles were published in prestigious scientific journals to emphasize these results, such as:

- **"Magnetic nanowires substrate increases adipose‑derived mesenchymal cells osteogenesis"** published in *Scientific Reports (2022) 12:16698 (Factor de impact ISI 5)*
- **"Synthesis and Characterization of Gold-Shell Magnetic Nanowires for Theranostic Applications"** published in *Coatings* in November 2022 (Factor de impact ISI 3,12)
- **"A simplified protocol for sample preparation for scanning electron microscopy allows reliable imaging of nanomaterials adhering to cell surface"** sent for publishing at *International Journal for Molecular Sciences 2022***,** (Factor de impact ISI 6,01) **– the paper was accepted after some revisions.**

  "Cancer Cell Destruction by Magneto-Mechanical Actuation of Nanowires Compared with Nano/Micromagnetic Particles", a brief report published in *Journal of Biomedical Research & Environmental Sciences,* August 2022.

The **results obtained in this activity were communicated at** prestigious conferences, in 5 communications, as follows,

- **"Magnetic Nanowires for Cancer Cell Destruction by Magneto-mechanical Actuation" -** *European Magnetic Sensors and Actuators Conference*, Madrid, July 2022;
- **"A straightforward method for cell sample preparation to allow a reliable image of the nanomaterials adhering to the surface, using scanning electron microscopy" -** *Analytical and Nanoanalytical Methods for Biomedical and Environmental Sciences*, Brașov, June 2022;
- **"STEM cells carriers of Fe-Cr-Nb-B ferromagnetic particles for cancer cell destruction by magneto-mechanical actuation" -** *13th International Conference on the Scientific and Clinical Applications of Magnetic Carriers,* London, June 2022;
- **"Fe-Co Soft Magnetic Nanowires for Cancer Cell Destruction by Magneto-mechanical Actuation" -** *25th Soft Magnetic Materials Conference***,** Grenoble, May 2022;
- **"Cancer cell destruction by magneto-mechanical actuation of nanowires compared with nano/micromagnetic particles" -** *67th Annual Conference on Magnetism and Magnetic Materials (MMM 2022)***,** Mineapolis, MN, USA, November 2022.

We wrote 2 chapters in the book **"Magnetic Sensors and Actuators in Medicine"** edited by **Chiriac Horia and Lupu Nicoleta** in **the Elsevier Publishing House, which will appear in 2023.**