Abstract

The present thesis is about the modeling and solving of computational problems for the study of the experimental setup of hyperthermia for in – vitro experiments. One major problem that comes to consideration is the heating of the coil surrounding the solution, leading to the undesirable rise of its temperature. There is no way to counter that rise, so as to limit it down. The present study focuses on trying to evaluate the role of coil's temperature's rise and fall to the change of temperature inside the solution, before entering nanoparticles in it. For that purpose, Comsol Multiphysics was used in order to design the numerical simulation so as to determinate temperature's distribution. This software can easily extend convectional models for one type of physics into multiphysics models that solve coupled physics phenomena simultaneously. So, the electrical and the thermal problem were solved, calculating the magnetic field and the temperature respectively of the coil and the solution. The experiments were repeated for both experimental setups of the laboratory, one consisting of two circular coils (SPG-06AB-III, 765kHz) and one of eight squared coils (EASY HEAT, 210 kHz), without any nanoparticles existing inside the solution but the water flow. Both the proximity and the skin effect inside the coil were described. Moreover, the behavior of the two different setups was compared for different values of the heat transfer coefficient. The experiments were carried out for water temperature 20^{o}-C (experiments taking place on spring – summer) and for water temperature 13^{o}-C (experiments on autumn – winter). It is shown that there is an undesirable rise in the temperature of the solution at around 30% because of the coil, underlining the urgency for better insulation of the set up. It was proved that the squared coil set up causes less computational errors, while the best experimental conditions are about the second set up; the temperature range is 0.5^{o}-C less, comparing to the first one (for either heating or cooling). Furthermore, the magnetic field distribution in the second set up is more uniform than the first one, leading to a better heat transfer to nanoparticles. Finally, a model consisting of two square coils was designed and was compared to the one with the circular coils, emphasizing the contribution of geometry to the set up. The result was that the geometry only itself was enough for less heat transfer to the solution.