LC – AMF System Mediated Cancer Cell Apoptosis Microscopy Study

Magnetic nanoparticles mediated - magnetic fluid hyperthermia is a multidisciplinary topic that has seen various developments over the past three decades. However due to lack of communication between pure biologists, physicists, chemists and material scientists, most researchers still use induction heating devices for this research. Taking this fact into consideration nanoTherics provides a purpose built device with suitable accessories for the researchers in the aforementioned fields trying to bridge the gap.

This article focuses on the necessary requirements for cell biology AMF research and how LC-AMF system enables these inevitabilities. Including: repeatability of *in vitro* experiments, *In vitro* microscopy, time lapse analysis and non-contact temperature sensing.

Repeatability of the experiment

Cell culture positioning

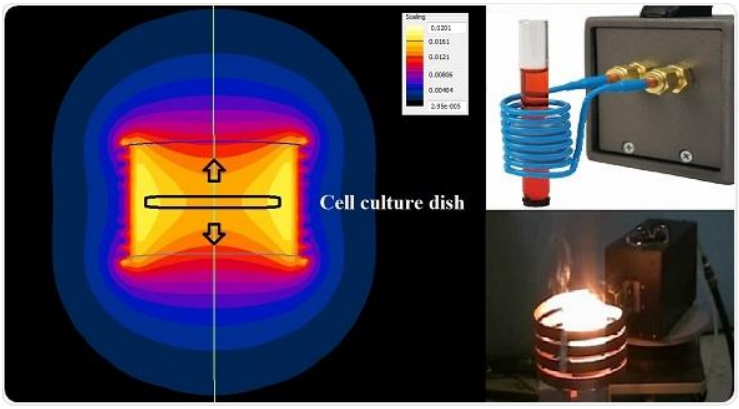

Fig.1

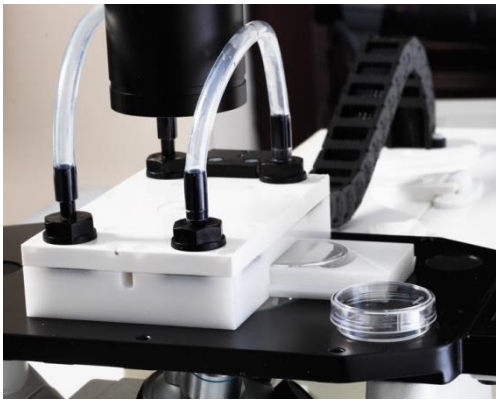

Fig. 2

Figure 1*: Induction heating coil simulation with cell culture dish and crude sample positioning techniques used in induction heaters.*
Figure 2: *Sample positioning within the fixed petri dish chamber in LC AMF enables repeatability for cell culture experiments.*

Finite Element Method Model simulation, clearly shows the magnetic field does vary within the coil for the simple solenoids used in induction heaters. Therefore, small millimetre variations do affect the field strength intensity experienced by the cells. This doesn't allow for experimental repetition with the same conditions due to crude sample positioning techniques, as shown in Figure 1. Accordingly, it is very clear that cell culture positioning and repeated exposure to the same AMF conditions is difficult with the crude sample positioning set up found with induction heating.

The LC-AMF system is compatible with nanoTherics' magneTherm technology, which eliminates the above-mentioned difficulties, allows researchers to position the cell culture plate in the same position and expose the cells to the same AMF conditions by providing an appropriate 35 mm2 cell culture dish/ plate chamber.

In vitro microscopy/ time lapse analysis

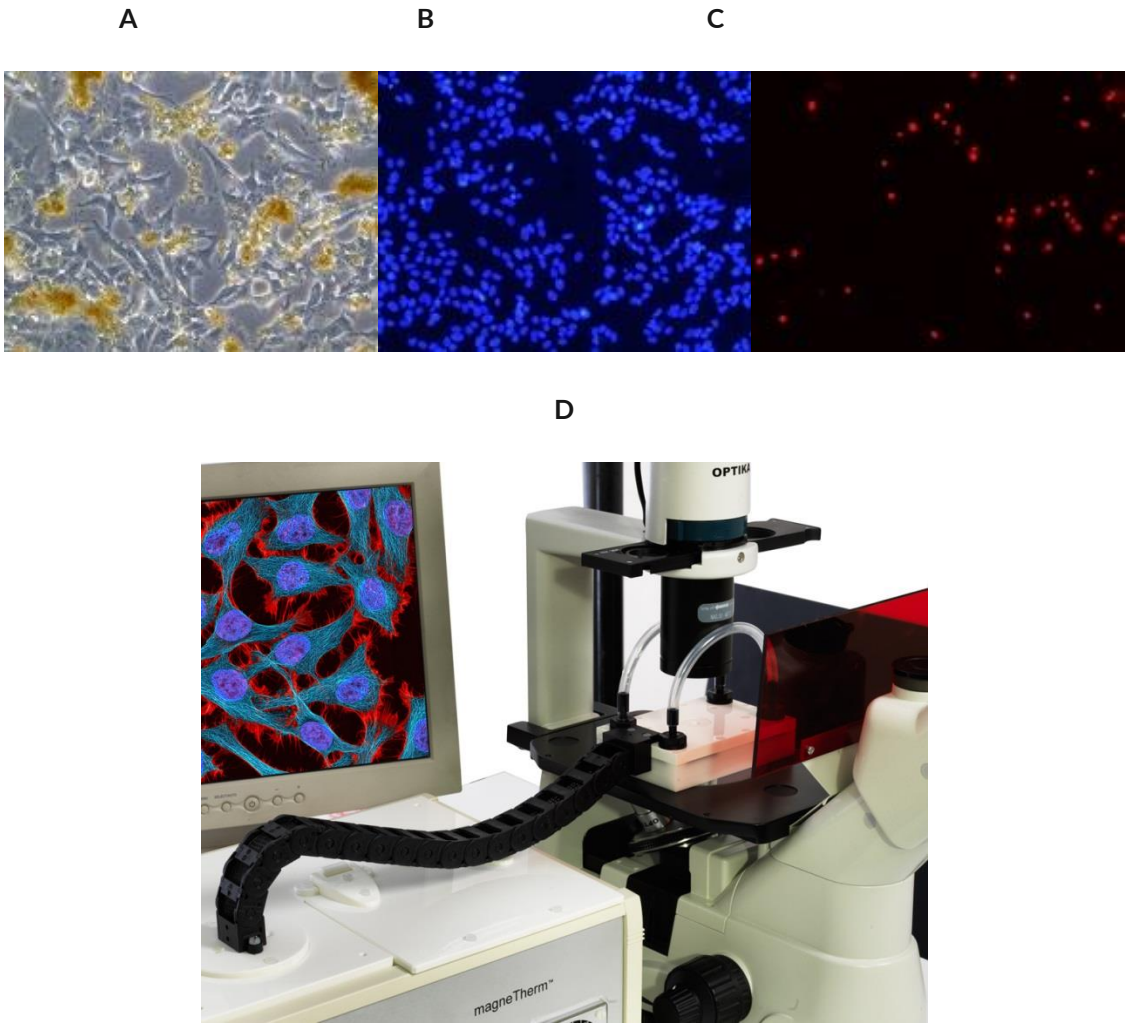

Figure 3: *(A) Phase contrast image of neuronal cancer cells with hypermagTM - magnetite nanoparticles; (B) Hoechst stain showing the total number of cells in the field of view; (C) Propidium iodide stain showing the dead cells in the field of view; (D) LC-AMF system mounted onto a microscope for real time AMF exposure analysis on cultured cells.*

The above AMF experiment on neuronal cancer cells performed using LC-AMF system demonstrates that this unique system can be mounted on a microscope and allows research to perform AMF mediated microscope experiments.

The additional feature that no other nanoparticle heating instrument can provide is that this LC-AMF system allows the researchers to maintain the cells at the physiological temperature at 37 ° C and allow 5 % CO2 gas flow to mimic a cell culture incubator on a microscope stage which enables time lapse imaging.

Non-contact temperature measurement

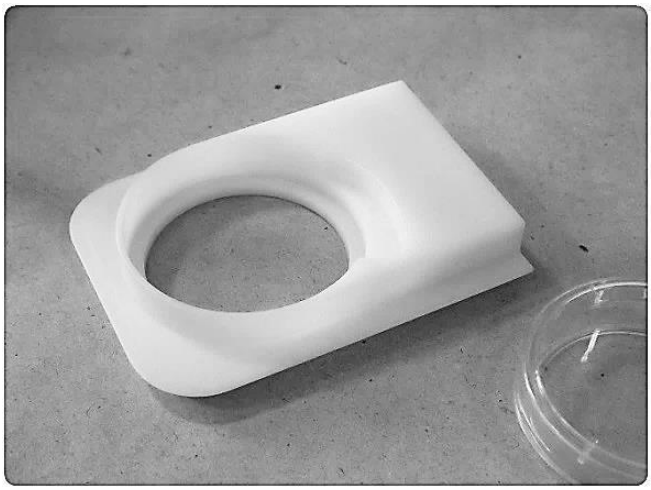

Fig. 4

Figure 4: *Petri dish holder which can accommodate a standard 35 mm petri plate.*

In vitro non-contact temperature measurement has always been a challenge for researchers when it includes AMF. Probes like thermocouple / optical sensors introduce contact measurement involving cross contamination which makes time lapse experiments difficult with these probes.

Similarly infra-red gun or infra-red cameras are not useful because they utilise near infra-red waves which cannot detect radiation behind glass or plastics used in the cell culture dishes. Keeping the lid open for a long time creates difficulties such as: contamination, heat loss, cell death, and doesn't allow experiments involving long exposure.

nanoTherics provides a solution for this because LC-AMF system provides a unique patented technology to maintain the cells and allow real time non-contact temperature measurement with thermocouple, optical sensor, infra-red gun and infra-red cameras and it is completely transparent for microscopy.