Mag(net)ic FUN

Functionalized Magnetic Nanoparticles and their Application in Chemistry and Biomedicine

NEWSLETTER
Issue 8, April 2015

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Our Research Institutions at a glance: NANO

NanoTherics Ltd. was founded in 2007 as a spin-off company from Keele University, Stoke-on-Trent, UK. The Company was established with technologies and products resulting from leading edge research into the use of magnetic nanoparticles for biomedical applications conducted at Keele University and University of Florida.
The aim of NanoTherics is to provide know-how and superior performance magnetic based tools to address global markets and to underpin the research and development of current and future nanoparticle, magnetic particle, cancer therapy, drug delivery, genetic screening and gene therapy programs.
The NanoTherics product range includes devices and reagents for magnet assisted transfection and delivery of biomaterials into cells for the life science research and development market as well as products for nanoparticle heating applications utilizing AC field and solenoid coil principles.

Magnefect Range

The magnefect series of magnet-based transfection devices and magnetic nanoparticles significantly enhance transfection efficiency and cell viability via the unique magnet assisted transfection technology. NanoTherics transfection technologies use magnetic nanoparticles and oscillating magnetic fields to accurately and rapidly transfect biomaterials into cells.

MagneTherm™

The magneTherm™ system is a totally unique, very competitively priced, device which enables magnetic fluid and nanoparticle hyperthermia testing. It operates at a wide range of user-configurable frequencies in one system with no hidden extras needed.

Figure 1. NanoTherics product range.

NanoTherics has recognised the difficulty in sourcing off-the-shelf equipment which meets this need yet still allows for flexibility in choice of frequencies (low and high) used.
The magneTherm™ system has been designed specifically for this purpose, operating at a wide range of frequencies with field strengths up to 20 kA/m (25 mT) all in one system with no hidden extras needed. Since the heating capacity of magnetic nanoparticles will vary, depending on size, shape and material properties, it is critical to be able to evaluate heating capacity over a broader range of frequencies.

The most recent innovation in the field of nanoparticle heating offered by nanoTherics is a Live Cell Alternating Magnetic Field exposure system (LC-AMF System) for in vitro time lapse imaging providing researchers the opportunity to combine exposure to AMF with microscope analysis in one experimental set-up.

Keele workshop

On March 23 and 24, 2015, a new workshop of the network took place at Keele University, UK. Following with our schedule the program was focused on **'Drug/Gene delivery and hyperthermia applications using magnetic nanoparticles as smart platforms'**. The following initiatives were presented to the students:

- Magnetic Nanoparticles for Cell Therapies in Regenerative Neurology
- The Magnetics of Magnetic Hyperthermia
- Application of Synthetic DNA in Stream Tracer Injection Experiments
- Interactive Training Session – Managing Intellectual Property

In addition to the training section, all the Mag(net)icFun students gave presentations on their research projects as part of their Ph.D. or postdoctoral experience being jointly supervised between PIs of their home and host institution.

Scientific achievements

As usual, in this section of the newsletter we want to highlight the scientific achievements of one of the students of our network. In this issue Dalibor Soukup from the University of Keele will present the last results of his Ph.D.

Dalibor Soukup, UKEE: Magnetization relaxation mechanisms strongly influence how magnetic nanoparticles respond to high-frequency fields in applications such as magnetic hyperthermia. The dominant mechanism depends on the mobility of the particles, which will be affected in turn by their micro-environment. In this study a novel application of AC susceptometry is used to follow the *in situ* magnetic response of model systems of blocked and superparamagnetic nanoparticles, following their cellular internalization and subsequent release by freeze-thaw lysis.

The AC susceptibility signal from internalized particles in live cells showed only Néel relaxation, consistent with measurements of immobilized nanoparticle suspensions. However, Brownian relaxation was restored after cell lysis, indicating that the immobilization effect was reversible and that nanoparticle integrity was maintained in the cells. The results presented demonstrate that cellular internalization can disable Brownian relaxation, which has significant implications for designing suitable nanoparticles for intracellular hyperthermia applications.

Further to this, the results highlight the possibility that particles could be released in reusable form from degrading cells following hyperthermia treatment, and subsequently reabsorbed by viable cells.

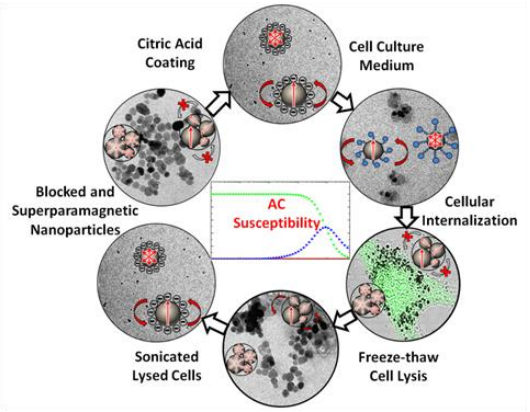

Figure 2. Graphical representation of the research project.

News from the network

- In August 2015 our Mag(net)icFun network will join the ACS meeting and will organize the symposium on Magnetic nanoparticles for catalysts and reagents.

- Fellows publications of the network: http://www.magneticfun.eu/publication.php

  - **D. Soukup**, S. Moise , E. Cespedes, **J. Dobson** , **N.D. Telling**, *'In Situ Measurement of Magnetization Relaxation of Internalized Nanoparticles in Live Cells'*, *ACS NANO*, 2015, **9(1)**, 231-240.

  - C. Hofer, **V. Zlateski**, P. Stoessel, D. Paunescu, E. Schneider, **R. Grass**, M. Zeltner, **W. Stark**, '*Stable Dispersion of Azide Functionalized Ferromagnetic Metal Nanoparticles*' , *Chem. Commun.* 2015, **51**, 1826-1829.

  - **M. Puddu**, D. Mohn, M. Zenobi-Wong, **W. Stark**, **R. Grass**, '*Magnetically deliverable calcium phosphate nanoparticles for localized gene expression*', *RSC Advances*, 2015, **5**, 9997-10004.

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