Magnetic Nanoparticle Multiplexing Experiments with magnet herm

Principle behind magnetic nanoparticle multiplexing

Magnetic anisotropy of a magnetic nanoparticle is the directional dependence of that nanoparticle's magnetic properties. In the absence of an applied magnetic field, a magnetically isotropic nanoparticle has no partisan direction for its magnetic moment, whereas a magnetically anisotropic material will align its moment along certain axes which are at lower energy than the others.

Super paramagnetic iron oxide nanoparticles (SPIONs) with different magnetic anisotropy properties behave differently under the influence of an external applied magnetic field.

Single domain magnetic nanoparticles with high anisotropy may dissipate heat at a low frequency with a high field amplitude, as the particles' magnetization rate is low at low field amplitude, and vice versa for magnetic nanoparticles with low anisotropy.

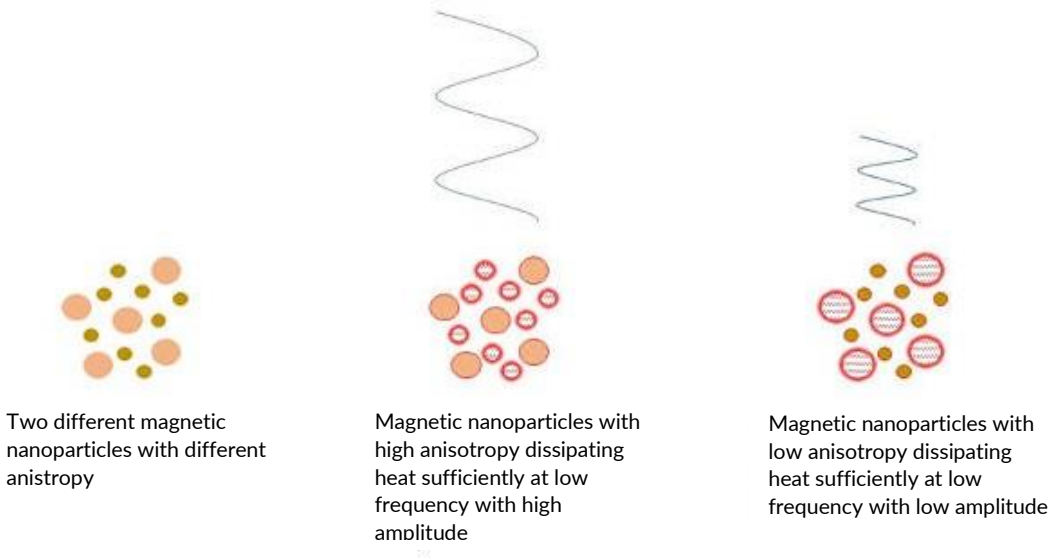

***Figure 1**: Magnetic nanoparticle multiplexing: Different types of magnetic nanoparticles dissipating heat at different rates when exposed to varying frequency and field amplitude.*

This phenomenon allows a novel biomedical application, multiplexing, in which different types of magnetic nanoparticle are positioned side by side and subjected to an AC magnetic field of varying frequency and field amplitude.

The design and fabrication of magnetic nanoparticles has seen much development in the past decade, which has enabled researchers to synthesize uniform magnetic nanoparticles with control over their physical and chemical properties such as size, saturation magnetization, surface functionalization (biocompatible coating), target specificity (antibody coating), chemical doping (Copper, Cobalt, Manganese), colloidal stability, viscosity, pH, etc. This clearly suggests that single domain magnetic nanoparticles with different anisotropies can be engineered for specific applications.

Possible biomedical applications

Some of the potential applications of this multiplexing phenomenon of magnetic nanoparticles include:

- Combination therapy: Targeted drug delivery with magnetic fluid hyperthermia
- Controlling calcium ion channels for possible insulin release control in Beta cells
- Stimulating action potential in different neuronal cells simultaneously
- Possible temperature dependent action potential in muscle fibres.

magneTherms' role in magnetic nanoparticle multiplexing research

This unique technology designed to the highest standards and specifically for purpose by nanoTherics has helped researchers worldwide to perform alternating magnetic field mediated research. The system can provide an AC magnetic field of varying amplitude at frequencies ranging between 50 kHz – 1 MHz.

Researchers worldwide have demonstrated AC magnetic field mediated drug delivery, magnetic fluid hyperthermia, AC magnetic field mediated Calcium influx, AC magnetic field mediated neuron stimulation.

(Please contact nanoTherics for the research articles magneTherm citation list).

Different types of magnetic nanoparticles in close proximity to each other can be exposed to varying frequencies with different field amplitudes using magneTherm technology and this allows the users to perform various multiplexed calorimetry, *in vivo or in vitro* experiments.