

Nanoparticle Heating Studies – The Need for Complete Assessment of Frequency Response Profiles

Many people are studying the heating responses of magnetic nanoparticles in alternating magnetic field (AMF) environments to evaluate their suitability for a range of applications.

However, these studies could be failing to capture vital information, primarily due to a lack of capability in the basic induction heaters that they are using. These conventional induction heaters are designed specifically to heat metal components – this means that they have a very limited frequency range.

Frequency Response Profiles

At NanoTherics, we are often asked why we offer ten frequencies as standard in our magnetic nanoparticle heating equipment, when many publications simply show one or two.

Subjecting particles to as many frequencies as possible, across as wide a range as possible, is absolutely essential to get a complete picture of the properties of a nanoparticle sample. This full picture allows the suitability of the particles for a particular application to be properly assessed.

Using a single frequency will only provide a snapshot, and not a full Frequency Response Profile (FRP).

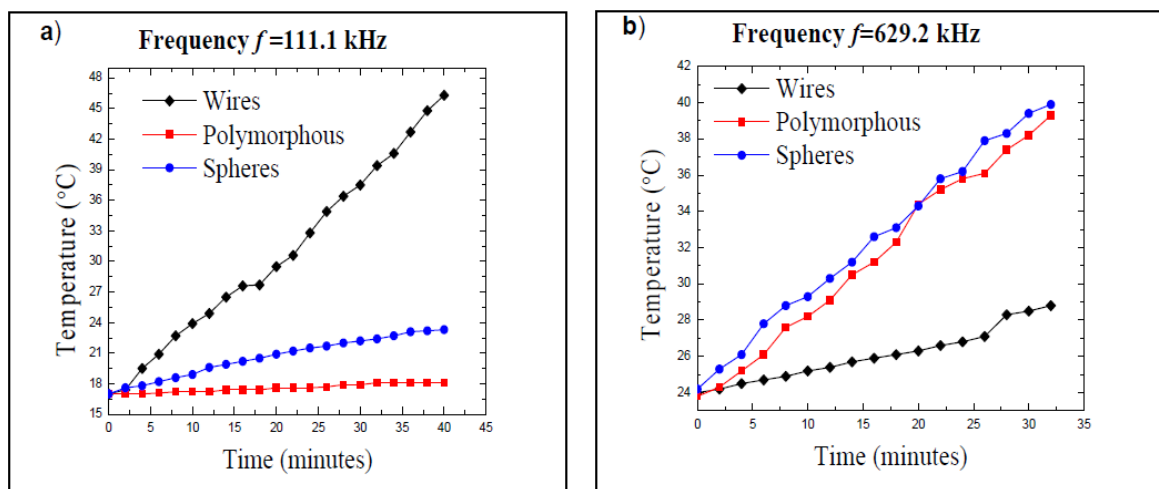


Figure 1: Hyperthermia data comparing the frequency dependence for different nanocrystal morphologies (22 nm spheres, polymorphous nanocrystals, and 55×2 nm wires). Ref: Iron Leisha M. Armijo et al., 2012.

Oxide Nanocrystals for Magnetic Hyperthermia Applications. *Nanomaterials* 2012, 2, 134-146

As can clearly be seen from the previous data, particles of different sizes and shapes will respond very differently at different frequencies and field strengths. Researchers will not see the full and complete picture if they can only analyse their particles using frequencies of between 150 kHz and 450 kHz, for example (a very common frequency range capability for induction heaters). Using a wider range of frequencies allows a full Frequency Response Profile to be built.

MagneTherm™ from Nanotherics

magneTherm™ offers ten frequencies as standard from 100 kHz to 1MHz. The system is capable of frequencies as low as 50 KHz, and can provide up to 25 individual frequencies, if all options are included. This provides the most comprehensive range of applicable and relevant frequencies of any induction heating system available.

The magneTherm has been designed specifically for nanoparticle heating applications, operating at a wide range of frequencies (from 100 kHz to 1MHz) with field strengths up to 20 kA/m (25 mT), in one complete system. 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 (SAR/SLP/ILP) over as broad a range of frequencies as possible.

The magneTherm system was purpose built for this specific application and is designed to be the most flexible, affordable, reliable and scientifically fit for application bench top device available today – the magneTherm has undergone several design iterations and improvements during its lifetime and now represents a technologically adept solution for all magnetic nanoparticle heating applications.

The magneTherm covers all aspects and applications from calorimetry, in vitro, in vivo, drug delivery and release applications in a single, affordable solution – no need for multiple, expensive applicators, just a single system with multiple optional accessories that can expand the application range as required.



For more information or to request a quotation please visit
www.nanotherics.com.