NanoMag Survey #2
Questions by Luis Barquin
Closed April 20th, 2014

Open-ended questions only:

3. Have you ever used X-Ray diffraction to characterise your nanoparticles?

- It is a useful technique used for very niche purposes
- R&D characterisation using X-Ray, but find it too expensive to use as a standard characterisation technique or QC method

4. Have you ever used TEM to characterise your nanoparticles?

- Use SEM instead
- Also useful to support particle size distribution and only used occasionally
- TEM is too expensive to use as a standard characterisation method. Most magnetic particle manufacturers would not have a TEM.
- It would be useful to have the ability to characterise in the liquid state more readily (e.g. liquid flow holder from Hummingbird Scientific).
- Powerful direct imaging method; studying exclusively micro-meter size multicore magnetic beads and therefore TEM gives only a cross-section and therefore only a limited part of the entire particle.
- [TEM] is very useful for size distribution

5. Have you ever obtained the hydrodynamic size of your nanoparticles? If so, would you please explain the method?

- Dynamic Light Scattering (20 responses; 12 with comments)
    - Interpretation is not easy and in certain cases (agglumeration) not possible. Used MRX for this, which worked nicely (binding assay possible).
    - Use DLS (Malvern ZetaSizer) as part of standard particle characterisation
    - DLS or single particle tracking (Nanosight) is available around AF4 or coulter counters (eg. iZon) are the other options.
    - SEC
    - It allows the determination of particle's diffusion coefficient in a different media by analysing the scattered intensity. Using the Stoke's Einstein's Law, the hydrodynamic radius can be obtained.
    - Some EM confirmation
    - Resistive pulse-sensing using Nano instruments (iZon)
    - In batch mode DLS or from retention times in asymmetrical flow field-flow fractionation (AF4)
    - Nanosight (twice)
    - Nanoparticle Tracking
    - Rely on the specification given by the supplier. The hydrodynamic size can be measured easily with DLS and results tend to be consistent. In core-size it becomes much more complicated, usually based on TEM, but results on same particles can vary a lot.
- Photon Cross-correlation Spectroscopy (PCCS) (twice)

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- Assume that the hydrodynamic size to be equal to the physical size obtained by electron microscopy
- The hydrodynamic radius of the sample distribution can be obtained from the elution times. The hydrodynamic radius (rh) is obtained from the Stokes-Einstein where kb is the Boltzmann constant, T is the temperature, η is the dynamic viscosity of the solvent and Di is the diffusion coefficient. In turn, the diffusion coefficient was obtained with a equation that takes into consideration the position of sample component along the channel, time, a constant 'k' which includes flow conditions and geometrical parameters, and Vc as the cross-flow rate.

6. If using Fe-oxides what technique would you use to determine the concentration?

- Densitometer
- Inductive Couple Plasma Mass Spectroscopy (ICP-MS); ICP-OES, ICP-AES
- UV Visible Spectroscopy
- VSM and/or Magnetic Guoy method
- Iron dosage
- Elemental analysis
- Nanosight
- Absorption spectrum
- Magnetisation curves
- Colormetric Determination AAS
- Suspension by gravimetry. The iron concentration is measured with a photometric method using the Spectroquant iron kit (Merck) against a Titrisol iron standard (MERCK)
- Solid volume concentration , “magnetic” volume concentration of magnetic nanoparticles in magnetic fluids
- In labs with fewer capabilities photometric methods (phenantroline assay or Prussian blue staining) are preferred

7. In magnetic nanoparticles, have you ever used any of the following methods to characterise your nanoparticle?

- Also use the SENSEMAG (Imego-Acreo)
- Magnetic susceptibility, hysteresis
- AC susceptibility methods

8. In nanoparticles, have you ever approached or performed a test of biocompatibility?

- This has to be performed by specialists from the biological area. The results will strongly depend on the actual setting of the test. It is of great importance, to mimic the application scenario as much as possible in the biocompatibility test.
- Test cytotoxicity in GLP approved lab
- It’s of interest
- Used standard ISO 10993 tests
- Focus on in-vitro diagnostics
- Preparation of CE submission, to determine hazard in blood count

Continued…

Question 8 continued…

- Measured with partners, the toxicitiy and proliferation rate of stem cells labelled with Rienso/Feraheme and labelled with magnetoliposomes. This was in-vitro, as preparation test for in-vivo experiments. Also measure the long term fate of the particles in the animal body to determine the biocompatibility, blood clearance rate, biodistribution and the particle content is measured in animal tissues and blood samples.

10. If there was a technique necessary to characterise nanoparticles in a standardise process, and out of your experienced capabilities, would you be willing to approach a university, institute or technological?

- Don't have TEM capabilities and are regularly approaching other universities for those measurements.
- Metrology institute
- Already collaborate with the above organisations in various parts of the world
- Would try to avoid this situation. There is also a difference in the type of company to approach. They would have to be certified and follow a quality level of ISO 9001, ISO 13485 or higher.
- CNRS
- University or research institute (2 times)
- Local university; preferably in London or Cambridge
- ICMAB-CSIC, UAB or UB (Barcelona, Spain)
- University of Zaragoza
- Have tried several technologies at universities to test the presence and properties of MNP in medical devices. So far no simple method for QC has been found or elaborated.
- Have a very developed relationship to characterise the nanoparticles.
- Prefer a laboratory, which is accredited for this method

11. Would any of your colleagues/collaborators/customers be interested to collaborate (or to know more) about the NanoMag project?

- Currently studying interactions of SPIONs in animals and Biological test systems - Research Centre in Copenhagen would be interested