Electronic Supplementary Information

For an isolated single magnetic nanoparticle the critical size below which the particle becomes superparamagnetic, V_c, is given by[1]

$$V_c = \ln\left(\frac{\tau_{meas}}{\tau_o}\right)\frac{kT}{K} \tag{A.1}$$

where t_{meas} is the measurement observation time (normally taken as 100 seconds for magnetometry experiments), t_o is the average time between attempts (which is comparable to inverse of the Larmour precession frequency of about 10^{-9} to 10^{-10} seconds), k is Boltzmann constant (1.38×10^{-23} J K^{-1}), T is the temperature in Kelvin and K is the effective magnetic anisotropy constant of the particle in J m^{-3}.

The number-based average particle diameter (d_{TEM}) was calculated from

$$d_{TEM} \quad = \quad \frac{\sum N_i d_i}{\sum N_i} \tag{A.2}$$

and the number-based geometric standard deviation (σ_g) was calculated from

$$\ln \sigma_g \quad = \quad \sqrt{\frac{\sum N_i (\ln d_i - \ln d_{TEM})^2}{N_{total} - 1}} \tag{A.3}$$

In order to determine the particle size distribution from magnetic measurements anhysteretic curves were measured at high temperature (350 to 390 K) and were fitted with a Langevin function numerically integrated over a particle size distribution using a least squares routine. The final fitted equation had the form

$$M = \int M_s c L(\xi) dV + \chi_l H$$

where $L(\xi) = \coth \xi - 1/\xi$

and $\xi = \dfrac{\mu_0 M_s V H}{kT}$ (A.4)

where M_s is the saturation magnetisation, c is the volume fraction of magnetic particles, c_l is the linear susceptibility component, H is the applied magnetic field, V is the particle volume, μ_0 is the permeability of free space, k is the Boltzmann constant and T is the measurement temperature in Kelvin. Note that saturation magnetisation was allowed to refine during fitting within ± 20% limit of the value for the magnetisation at 70 kOe. In all cases the final value of saturation magnetisation was within 10% of the value of the magnetisation at 70 kOe.