

AbstractID: 14212 Title: Quantitation of Nanoparticle Concentrations in Microscopic Bound States

Purpose: To measure the distribution of nanoparticles into microscopic bound states. Antibody targeting has had varying success primarily due to competing mechanisms of uptake, including nonspecific binding and phagocytic activity, and the inability of nanoparticles to penetrate the vascular barrier. Methods of estimating the number of nanoparticles in each bound state will allow us to understand the mechanisms that deprive nanoparticles of their ability to bind targeted antigens and allow us to design methods to enhancing the antigen binding.

Method and Materials: When a pure sinusoidal magnetic field is applied to magnetic nanoparticles, the signal at the harmonics of the applied field can be detected at very low concentrations of nanoparticles because there are no other sources of signal and the bandwidth of the measurement can be very narrow. Identical iron oxide nanoparticles (25nm) were a) in aqueous solution and b) bound to two-micron polystyrene beads. The phase and amplitude of the third and fifth harmonics were measured using applied fields with different frequencies and amplitudes. The signals from the two pure solutions were fit the signals from known combinations of the two solutions using a linear mixture model.

Results: The harmonics as a function of frequency and amplitude of the applied field from the two samples were linearly independent. The condition number was 31.8 when the amplitude was varied from 10mT to 24mT and 14.8 when frequency was changed over the range 300Hz to 2700Hz. For two frequencies, 570, 2100 Hz, the average measured error from a linear least squares fit of the data for three mixtures was 4.7% and the maximum was 28%.

Conclusion: MSB can be used to monitor the concentrations of nanoparticles in at least two bound states remotely with reasonable accuracy. The system is nonlinear so a nonlinear model would reduce the errors significantly.