Magnetometric Analysis of Pulmonary Retention of Particles

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Groups of rats were exposed to mixed aerosols of magnetite (Fe_2O_3) and titanium oxide (TiO_2) by single or multiple exposures. Using an array of 8 flux-gate magnetometers the rat lung burden of magnetite particles was analyzed *in vivo*. The maximum of the magnetic signal is independent of the location of the magnetic material within the space of the total lungs, a significant improvement over previous magnetometric systems. After magnetization of the retained particles by an external magnetic field of short duration (~0.01 sec.) the magnetic signal and its relaxation over 15 min. were recorded. The magnetometric signal was compared to the actual content of Fe_2O_3 determined by chemical analysis. The TiO_2 content was also assessed. The results showed that the magnetic signal was linearly proportional to the amount of the Fe_2O_3, when rats were measured at the same post-exposure times. Complementary *in vitro* results showed that lower viscosity of the environment surrounding the particles and lower concentration of Fe_2O_3 in the tissue decrease the measurable magnetic signal triggered by the same mass of Fe_2O_3. To determine the lung burdens quantitatively by magnetometry a correction factor for viscosity and concentration is required. On the other hand, the magnetometric signal may be indicative for the translocation of the particles within the lung tissue, from the alveoli into the interstitium. Therefore, magnetometry, in addition to being a non-invasive method for total particle retention measurement, may also be useful for assessing particle translocation within the lung.

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