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SUPERPARAMAGNETIC NANOPARTICLES IN THE HYPERTHERMIA TREATMENT OF CANCER AND OTHER MEDICAL APPLICATIONS

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The potential value of superparamagnetic nanoparticles for medical applications such as the hyperthermia treatment of cancer and as imaging agents for MRI has long been recognized. However, this potential has not been fully realized in the past because of the difficulties in achieving stable dispersions of the very high specific surface area superparamagnetic nanoparticles at adequate concentrations. In this work we have designed stabilizing polymers based on reversible addition fragmentation chain transfer (RAFT) controlled radical polymerization processes to largely overcome these problems.

Superparamagnetic particles subjected to an oscillating magnetic field of appropriate strength and frequency will generate heat. The anatomy of a liver cancer tumour is such that 32 micron particles injected into the hepatic artery will become lodged in the blood vessels of the tumour. The patient can then be put into an oscillating magnetic field so that the particles generate heat and kill the tumour with little collateral damage. 32 micron particles have been prepared, containing approximately 10^9 individually stabilized magnetic nanoparticles/micro particle, that have generated the amount of heat calculated to be required.

In separate work, 5 nm superparamagnetic particles have been individually stabilized in concentrated salt solution at concentrations of approximately 10^{21} particles/L. These particles are stable to dilution and can even be dialysed without loss of stability. NMR studies have shown that they have potential as positive contrast agents for MRI.