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Biotemplated Magnetic Nanoparticle Arrays for Data Storage Applications

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Extended Abstract

Magnetic nanoparticles (MNPs) on surfaces are used for high density data storage, but for these applications the MNPs are required to have a uniform size, shape and crystallinity to ensure a consistent magnetic response. The current methods used for the manufacture of these MNP surfaces often requires the use of expensive facilities, harsh chemicals and high temperatures, making the production both expensive and unenvironmentally friendly. However, Arakaki et al. (2003) showed that the biomineralization protein Mms6 derived from the magnetotactic bacterium *M. magneticum* AMB-1 was able to template the formation of uniform cubo-octahedral magnetite under mild aqueous reaction conditions *in vitro*. In previous work Galloway et al. (2012a, b) has shown that recombinant Mms6 can be used to template the formation of consistent cubo-octahedral magnetite MNPs and facilitate the immobilization of these MNPs into micropatterned arrays, establishing a new bioinspired and green approach for the formation of bit patterned surfaces for data storage applications.

However, magnetite is a magnetically soft material that may not be very well suited for data storage, but Mms6 has also been shown to template the formation of cobalt doped magnetite in prior work by Galloway et al. (2011). This work has improved the magnetic hardness of the biotemplated MNP arrays by the controlled doping of cobalt into the nanoparticles, making them more suitable for data storage applications. Coupled with this the size of the biotemplated MNP patterns formed has been reduced from the microscale to the nanoscale, which would significantly improve the storage density of data storage devices manufactured in this way. The morphology of the MNPs has been imaged by techniques such as scanning electron microscopy (SEM) and atomic force microscopy (AFM), and both the long range and nanomagnetism of the samples have been characterized with techniques such as magnetic force microscopy (MFM) and the magneto-optic Kerr effect (MOKE). In the long term it is hoped that this technique can be adapted to immobilize any identified recombinant biomineralizing protein or peptide, to form a new bottom-up manufacturing technique and inspire a whole new range of bionanotechnologies.

References

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