Magnetic properties and switching dynamics of $L1_o$-FePt nanoparticles. Application to heat assisted magnetic recording

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An upper limit to the areal density of magnetic storage in hard disk drives of 20 Tb/in^2 is predicted [1] using a combination of heat assisted magnetic recording (HAMR) and a recording scheme that uses one FePt grain per bit. Currently areal densities are significantly smaller $\approx 1 Tb/in^2$, and progress is limited to less than 10% /year, as a result of significant challenges, some of which will be reviewed in this talk. The temperature dependence of the equilibrium magnetic properties of $L1_o$-chemically ordered FePt nanoparticles in the size range 3-7 nm is of fundamental importance in modeling the HAMR process using the Landau-Lifshitz-Bloch equation. Recent progress is based on Monte Carlo simulations and application of finite size scaling theory. Non-equilibrium spin dynamics simulations based on an atomistic model of $L1_o$-FePt are used to calculate the thermoremanence, optimize recording system parameters, calculate the recording time window and determine the thermomagnetic switching mechanism. Further challenges include multiscale modeling and development of a new cluster Monte Carlo algorithm.

[1] R.F.L. Evans, R.W. Chantrell, U. Nowak, A Lyberatos and H.J. Richter, APL 100, 102402 (2012)