Patterned media for high-density recording:
An overview and recent results

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The areal bit density of magnetic disk recording has made a colossal increase over the last decades. Extrapolation leads to recording parameters not likely to be achieved without changes in the present way of storing magnetic data. One of the potential solutions is the use of patterned media, which should consist of a regular two-dimensional array of single domain dots with large uniaxial magnetic anisotropy. Such media will shift the super paramagnetic limit positively in comparison with the present thin film media. Theoretically, a bit density in the order of Tbpsi is possible.

This paper will discuss the most valuable methods for preparing patterned media. Special attention will be paid to the Laser Interference Lithography (LIL) method as developed in the author's laboratory. Large areas of small Co/Pt magnetic dots (60nm) have been prepared. Analyses are carried out with standard methods such as VSM, Torque magnetometer, MFM etc. From large-scale micromagnetic simulations we predicted that our 30 nm thick Co/Pt multilayer dots are single domain for dot diameters below 75 nm. This is in agreement with MFM experiments that show that the two-domain state is stable in 180 nm dots but not in 70 nm dots. The simulation results also show that the dot shape, dot size and local anisotropy variations has a significant effect on the switching field value.

Beside micromagnetic simulations we are developing experimental set-ups to investigate the magnetic behavior of small dots. With our homemade MFM it is possible to image an array of dots applying or in the presence of a high magnetic field. which is mounted in between the pole's of conventional electromagnet with maximum field of 1353 kA/m (1.7T). Prelimary results will be presented in this paper. To understand the switching behavior of small dots in more detail the standard equipment such as VSM etc. is not sensitive enough.

For our dots, having perpendicular anisotropy we further developed the so-called Anomalous Hall measurements because this method has an extreme high sensitivity for measuring the AH voltage as a function of the applied field. From the AH hysteresis measurements we concluded that the switching behavior of one dot, having a diameter of 120nm, is very irregular.