Permanent magnet biased write heads for high coercivity media

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In recent years, the growth in areal storage density has become limited by the inability of inductive write heads to cope with the increases in media coercivity necessary to maintain thermal stability. One method which has been suggested to get around this problem (superparamagnetic effect) is thermally assisted recording (TAR) where the medium is heated locally, e.g. with a laser beam, bringing the coercivity down during the write process. We suggest instead a method where a system of permanent magnets (PMs) provides a bias field just below the threshold for writing and an inductive writer provides an additional, modulated field doing the actual writing. Presented here is a write head for longitudinal recording consisting of a pair of PMs located in the write gap of a traditional write head. The magnetization vectors of the PMs are antiparallel and vertically oriented. By using rare earth magnets with high uniaxial anisotropy, $H_k > 100$ kOe, and high saturation magnetization, $M_s > 500$ G, high horizontal fields with high gradients can be achieved near the interface between the two magnets.

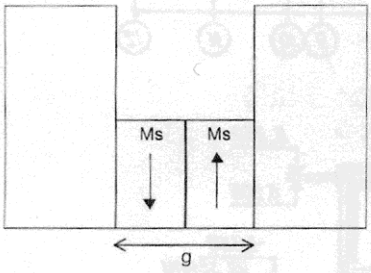

Figure 1: *Inductive write head with antiparallel PMs in gap.*

Figure 1 shows a simple sketch of the suggested arrangement of PMs in the write gap and figure 2 shows the effect of the PMs on the horizontal stray field at different distances. The example of figure 2 is calculated with a simple 2D FEM model using NdFeB PMs and Supermalloy pole pieces. The initial magnetizations are rotated slightly to compensate for the rotation caused by the deep gap field. The initial angle was chosen so that the vectors are antiparallel and vertical, as shown in fig. 1, at the full write current. A factor of 3 increase in write field with respect to the inductive writer is easily obtained.

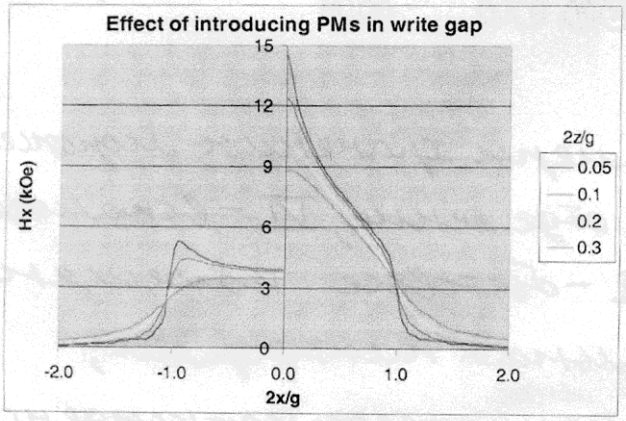

Figure 2: *Effect of PMs in gap. Left: inductive writer. Right: same writer with PMs in gap.*

A write element as shown in fig. 1 can only write bits with one magnetic orientation. A complete write head must thus consist of two such elements where one pre-magnetizes and the other overwrites the bits of opposite orientation. In the latter element, the write current is switched between positive and negative values, modulating the write field between saturation level and a non-writing level. Since the spatial field distribution from the PM pair is very different from that of the write gap, the PM field cannot be completely cancelled by a negative write field. This implies that media to be used with this type of write head must have nucleation fields in the second quadrant, at a considerable fraction of the coercivity.