Abstract

In this thesis, the magnetization of microstructured ferromagnets is studied with help of computer simulations in comparison to experiments. As experimental techniques magnetic-force microscopy and Hall μ-magnetometry are used. The latter measures the stray field generated by ferromagnetic elements in external magnetic fields. Comparison to simulated hysteresis curves of the magnetization gives the possibility to analyze the coercive and saturating fields of the particles. However, no statements can be made about the signal strength. For this reason, a computer code has been developed, which uses the output data of the micromagnetic simulations to calculate the stray field in arbitrary distances above the sample. The magnetization data is therefore interpreted as magnetic dipoles in the lattice cells, which have been defined for the simulation. The stray fields of the single dipoles are superimposed and can be visualized pointwise or utilized for further calculations. The measurement signal of Hall μ-magnetometry in the ballistic regime is simulated by averaging across the sensitive area above the Hall cross. The comparison between measurement and simulation yields good agreement.

As a second experimental method, magnetic-force microscopy is used. The resulting domain patterns are at first compared to simulated magnetization configurations. Since the measurement signal consists of contributions of all depths, it is rather complicated to interpret it in terms of magnetization. Again, the calculation of the corresponding signal from magnetization data serves for a direct comparison. The measurement signal corresponds to the second derivative of the stray field in out-of-plane direction, so that it can be calculated in connection to the stray field.

These calculations are performed on permalloy elements of various geometries. For comparison, a permalloy sample with distinct geometries and different film thicknesses in immediate neighborhood is prepared and measured by magnetic-force microscopy in the as-prepared state as well as in external magnetic fields. The investigation of domain walls in the structured material yields a transition between cross-tie and Bloch walls between 70 and 100 nm film thickness.