Abstract

The subject of this thesis at hand is the generation of pure spin currents in lateral spinvalves. Pure spin currents result from the accumulation of spins and give rise to spin transport in the absence of charge transport. The diffusive character of spin transport may be the key to prospective concepts for information transmission and processing with significantly reduced dissipation. The investigation of pure spin currents also contributes to a deeper understanding of spin-based phenomena such as magnetoresistance (e.g. GMR, TMR) and magnetization dynamics (e.g. spin-transfer torque STT) by addressing fundamental spin transport and relaxation processes.

In order to create a pure spin current, a charge current is injected into a ferromagnet/ nonmagnet interface. The multi-terminal geometry for local and non-local electrical transport measurements and the size of the diffusion channel needed for the generation and detection of pure spin currents require a sequence of laterally connected ferromagnetic and nonmagnetic leads on the submicron scale, the so called lateral spinvalve. Besides local and non-local electrical transport measurements, imaging of the ferromagnetic parts and the diffusion channel by scanning electron microscopy with polarization analysis (SEMPA) is employed as an analysis tool. The intent of applying SEMPA to the nonmagnetic diffusion channel is to directly image the spin accumulation, which would provide new knowledge about the dynamics, propagation, and relaxation of spin currents. The small information depth of SEMPA and the crucial importance of clean interfaces and surfaces for the creation of pure spin currents are the motivation to realize the entire sample fabrication and investigation *in situ* in a complex ultra-high vacuum system.

A novel multi-stage fabrication process based on thermal evaporation and structuring with an focused ion beam system (UHV-FIB) is developed. Thereby, the design of a sample layout giving rise to a single-domain magnetization patterns in the two ferromagnetic leads and allowing for high-resolution SEMPA imaging even during the current-induced generation of a pure spin current turned out to be the major challenge. The development steps to achieving these goals and the derived experience and know-how are presented in detail. An important aspect for interpreting the non-local transport signal in a spinvalve is the distinct understanding of the remagnetization processes in the nanoscale magnets. This is achieved by a combined analysis of 2-point measurements of the anisotropic magnetoresistance (AMR) effect and SEMPA images of the ferromagnets. For Co/Cu spinvalves the successful detection of pure spin currents is evidenced by correlating non-local electrical transport measurements to AMR and SEMPA data. The observed effect size is in agreement with published work of other groups and indicates the high quality of the ferromagnet/nonmagnet interfaces in our spinvalves. Imaging of the spin accumulation in the nonmagnet by SEMPA did not show not the assumed results. Likely reasons as well as other open questions are finally discussed.