Scanning Probe Microscopy for Imaging Magnetic and Ferroelectric Patterns on a Nanoscale

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Abstract

Scanning Probe Microscopy (SPM) has developed in a powerful tool to image different physical properties on the surface of solid samples. Two examples of dedicated Scanning Force Microscopy (SFM or AFM) are presented here: ii) In Piezo-response Force Microscopy (PFM) an oscillating bias potential is applied to a force sensor in order to image ferroelectric domain patterns, and i) in Magnetic Force Microscopy (MFM) an oscillating magnetic probe is used to visualize the stray field on magnetic samples.

i) The use of ferroelectric materials in the development of fast and non-volatile random access memory is very promising. PFM can be applied to study domain formation on a nanometer scale, and to conclude about the influence of grain boundaries on ferroelectric domain patterns. Furthermore, it is possible to use PFM for domain switching and writing. Examples are shown on single crystalline bulk material and on patterned thin film samples.

ii) The density in magnetic data storage has increased by almost three orders of magnitude in the last decade. MFM is very suitable for imaging these small magnetic patterns, but it is necessary to use high-resolution magnetic probes in a sophisticated operation mode in order to obtain the required 20 nm magnetic resolution. Examples are shown on in-plane and on perpendicular recording media, as well as on patterned research samples.

Author Biography

G. Tarrach studied Physics, Mathematics and business administration at Basle University .and finished his thesis with Prof. Güntherodt in 1993. Hi main research focus were the scanning near-field optical microscopy. From 1997-2002: he was assistant professor at the Pontificia Universidad Católica de Chile with projects in near-field optics and force microscopy and from 2002-2004: associate professor at the same university. Since 2004: he has been Chief technical officer (CTO) of SwissProbe Ltd in Basel, Switzerland