

Materials List for

Optimizing Magnetic Force Microscopy Resolution and Sensitivity to Visualize Nanoscale Magnetic Domains

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Materials

Name	Company	Catalog Number	Comments
Atomic force microscope	Bruker	Dimension Icon	Uses Nanoscope control software
Glovebox, inert atmosphere	MBraun	LabMaster Pro MB200B + MB20G gas purification unit	Custom design (leaktight electrical feedthroughs, vibration isolation, acoustical noise and air current minimization, etc.) and depth for use with Bruker Dimension Icon AFM, 3 gloves, argon atmosphere
MFM probe	Bruker	MESP	$k = 3 \text{ N/m}$, $f_0 = 75 \text{ kHz}$, $r = 35 \text{ nm}$, 400 Oe coercivity, $1 \times 10^{-13} \text{ EMU}$ moment. An improved version with tighter specifications, the MESP-V2, is now available. We have also used Bruker's MESP-RC (2x higher resonance frequency than the standard MESP, $f_0 = 150 \text{ kHz}$, with a marginally stiffer nominal spring constant of 5 N/m) and other MESP variants designed for low ($0.3 \times 10^{-13} \text{ EMU}$) or high ($3 \times 10^{-13} \text{ EMU}$) moment (i.e., MESP-LM or MESP-HM, respectively) or coercivity. A variety pack of 10 probes containing 4x regular MESP, 3x MESP-LM, and 3x MESP-HM variants is available from Bruker as MESPSP. Other vendors also manufacture MFM probes with specifications similar to the MESP (e.g., PPP-MFMR from Nanosensors, also available in a variety of variants, including -LC for low coercivity, -LM for low moment, and SSS for "super sharp" decreased tip radius; MAGT from AppNano, available in low moment [-LM] and high moment [-HM] variants). Similarly, Team Nanotec offers a line of high resolution MFM probes (HR-

			MFM) with several options in terms of cantilever spring constant and magnetic coating thickness.
MFM test sample	Bruker	MFMSAMPLE	Section of magnetic recording tape mounted on a 12 mm diameter steel puck; useful for troubleshooting and ensuring the MFM probe is magnetized and functioning properly
Nanscope Analysis	Bruker	Version 2.0	Free AFM image processing and analysis software package, but proprietary, designed for, and limited to Bruker AFMs; similar functionality is available from free, platform-independent AFM image processing and analysis software packages such as Gwyddion, WSxM, and others
Probe holder	Bruker	DAFMCH or DCHNM	Specific to the particular AFM used; DAFMCH is the standard contact and tapping mode probe holder, suitable for most MFM applications, while DCHNM is a special nonmagnet version for particularly sensitive MFM imaging
Probe magnetizer	Bruker	DMFM-START	MFM "starter kit" designed specifically for the Dimension Icon AFM; includes 1 box of 10 MESP probes (see above), a probe magnetizer (vertically aligned, ~2,000 Oe magnet in a mount designed to accommodate the DAFMCH or DCHNM probe holder, above), and a magnetic tape sample (MFMSAMPLE, above)
Sample Puck	Ted Pella	16218	Product number is for 15 mm diameter stainless steel sample puck. Also available in 6 mm, 10 mm, 12 mm, and 20 mm diameters at https://www.tedpella.com/AFM_html/AFM.aspx#anchor842459
Scanning electron microscope (SEM)	Zeiss Merlin	Gemini II	SEM parameters: 5 keV acceleration voltage, 30 pA electron current, 5 mm working distance. Due to nm scale ASI lattice features, the aperture and stigmation alignment were adjusted before acquisition to produce high quality images.