Sycopel Scientific Ltd

Molspin Vibrating Sample Magnetometer

VSM Nuvo MK 2

Recent advances in computing electronics combined with innovative design has allowed the development of a VSM (vibrating sample magnetometer) of outstanding price/performance ratio. The instrument is an integrated system with all the components in one compact unit - only the computer is separate. It uses a small cylindrical sample, 7mm in diameter and 9mm long. It can also use disposable syringes, in which case the sample has a volume of 0.15 ml.

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The sensitivity is high and will be described later. All the functions of the instrument are controlled by a computer, which sets the field, drives the vibrator, gathers the signal from the pickup coils and then stores and displays the result. Most of the complicated work occurs in the program, leaving the electronics to do the simple work. The program is simple to use, allowing great flexibility in the way data is gathered and displayed. The maximum field is I Tesla.

Operation: When the program is entered there are two choices. The first is called SET. In this mode any field up to I Tesla can be specified. When it is specified the field is set to this value and a measurement made. Thus trials of the material can be made before starting the other option which is LOOP. In this mode a series of fields is specified. When the field is taken up to the maximum and then measurements are made at all fields until zero is reached when the fields are repeated with the opposite polarity. At the end of the procedure the results are stored. Once the results are stored they can be plotted. The plot is scaled to fit the screen but can be modified to examine parts of it in greater detail. When the plot is on the screen a short line is shown. This line can be moved anywhere and matched in slope to any part of the loop. Once a match has been made the susceptibility at that point is displayed. With or without the susceptibility measurement the crossing points of the loop on the axes are found and displayed in terms of remanence and coercive force. For weak samples where the magnetism of the holder may be important the results from the empty holder can be subtracted from the sample results.

Field Setting Method: The field in the gap is measured by a Hall probe. When a field is selected the current is increased then a measurement made of the field. If the field is not yet great enough the field is increased by a factor that depends on the difference between the two, and the iterative process repeated until the target field is reached.

Vibrator and measurement technique: The vibrator is an electromagnetic type similar in the mechanism of a moving coil loudspeaker. The drive waveform (at about 70 cps) is derived from the computer via a digital-to- analogue converter. The waveform sent to the vibrator is interleaved with measurements of the amplified coil voltage via an analogue-to-digital converter. In this way lock-in amplifiers with their long settling times are not necessary and measurements can be made very quickly. It takes about 10 seconds per point measured.

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Sensitivity: Because there is a computer in the system the output from the coils when digitized can be multiplied by any factor. What limits the factor is the noise of the system. Noise is defined as the signal that occurs when a measurement is made with no sample present and this becomes meaningful when it is compared with the signal from a sample. Water makes a good demonstration subject. Since the holder is slightly magnetic the empty holder is measured first. Then a measurement of the holder filled with 0.46 ml of water is measured. The empty holder is then subtracted and the susceptibility of water can be measured and compared with the known result. The water trace gives a good idea of the noise level. The noise level is about 0.04 x 10-6 A m2 this is equivalent to the EMU value of 40 x 10-6 G cm3.

There is a 4 decade attenuator and on the setting of 1 the maximum moment is around 100 x 10-6 A.m2 on range 1000, the maximum moment is around 0.1 A.m2 or 100 G cm3.

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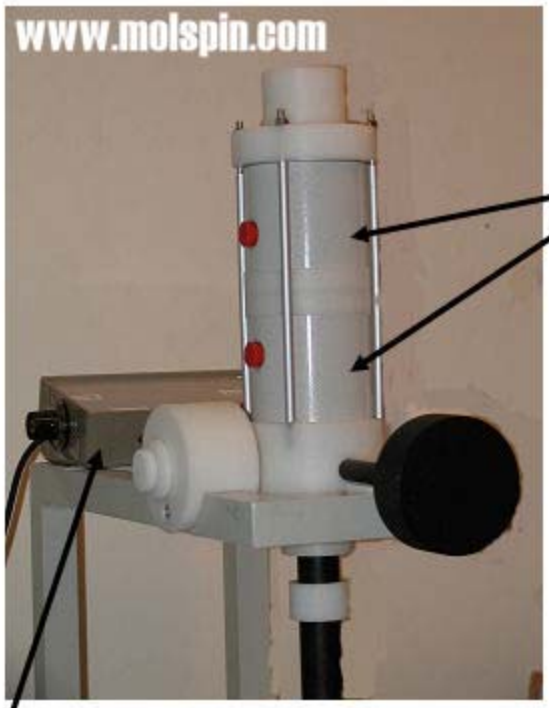

Two vibrators working in opposition

The control box at the back has controls that adjust both the phase and amplitude of the two vibrators.
This system of dynamic balancing has allowed the VSM a significant increase in sensitivity.

The screen below shows the performance of the new system where measurements may now be made on thin films -- the noise level is now 0.04 uA.m2 and the programs are now in windows format --

The screen for a typical measurement

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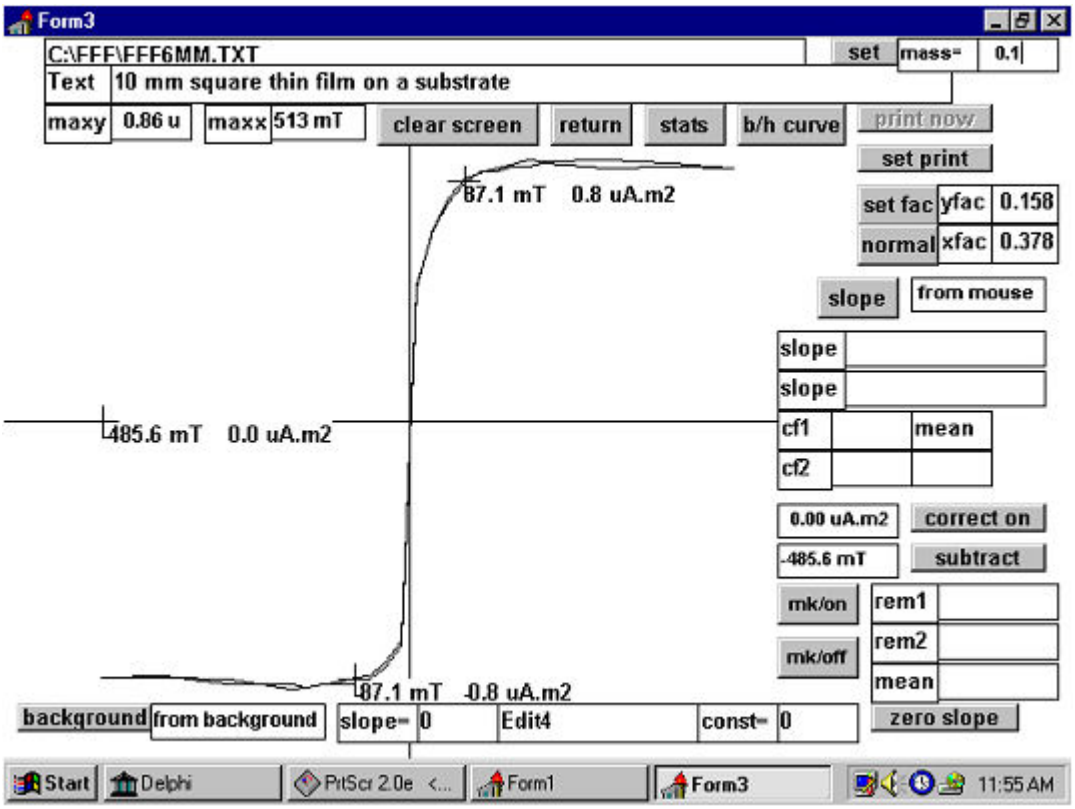

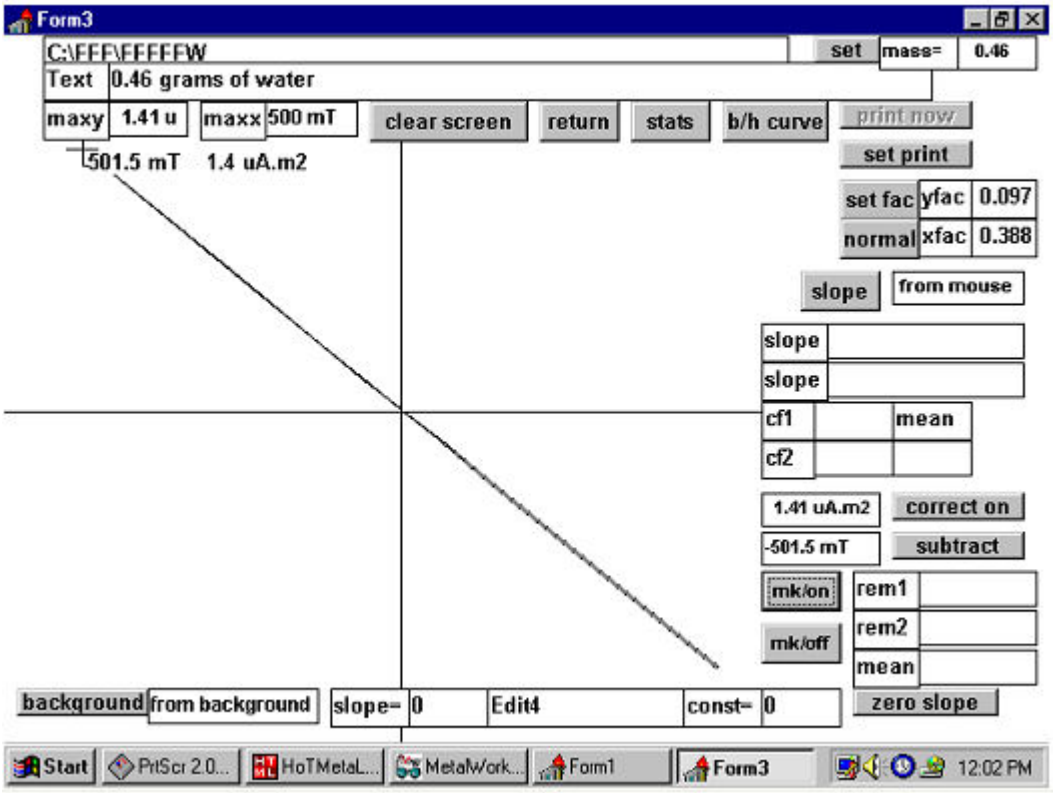

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