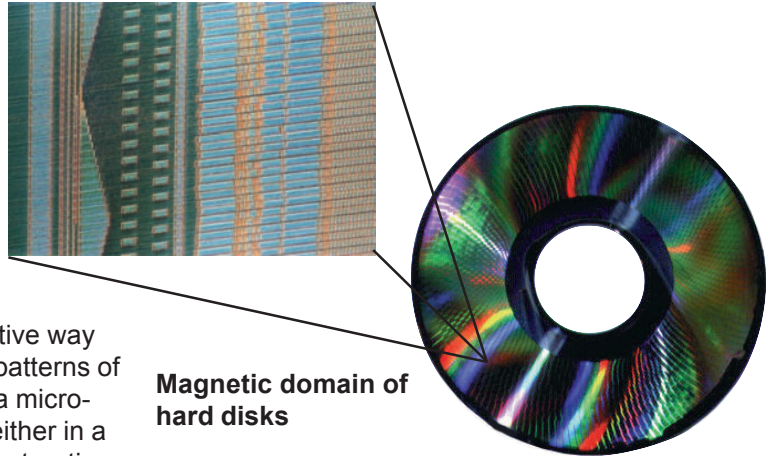


### Magnetic Domain Detection Using Ferrofluid

#### Domain Detection

Ferrofluids are extensively used for the study of magnetic domain structures in magnetic tapes, hard and floppy disks, magneto-optical disks, magnetic heads, crystalline and amorphous alloys, garnets, steels and geological rocks. Commercial applications include quality control of magnetic recording media and identification of microdefects in steels. EMG series ferrofluids offer a simple and cost-effective way to observe and measure the magnetic patterns of such materials, either directly or using a microscope. These ferrofluids are available either in a water- or mineral oil-base with various saturation magnetization values.



Magnetic domain of hard disks

#### Ferrofluid

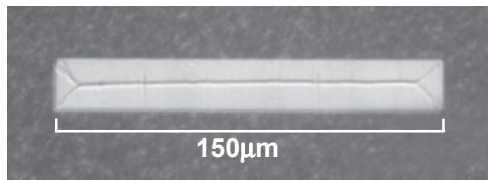
Ferrofluid is a stable colloidal suspension of single domain particles about 100Å in diameter. The colloidal particles in the ferrofluid are attracted to the regions of the maximum magnetic field under the influence of the field gradients of the domain walls. The particles therefore congregate at the domain boundaries which appear as dark lines in visible light. The

separation between the two dark lines is roughly equal to the size of a domain, and the dark line is the width of the wall or transition zone.

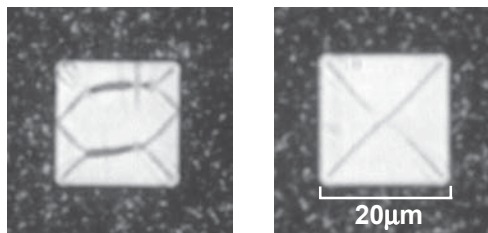
In visible light, the diffraction grating and birefringent effect produce spectacularly colorful patterns. When the colloidal pattern is observed with a scanning electron microscope (optional), the dark lines appear white.

#### Examples

##### Magnetic domain of thin permalloy film

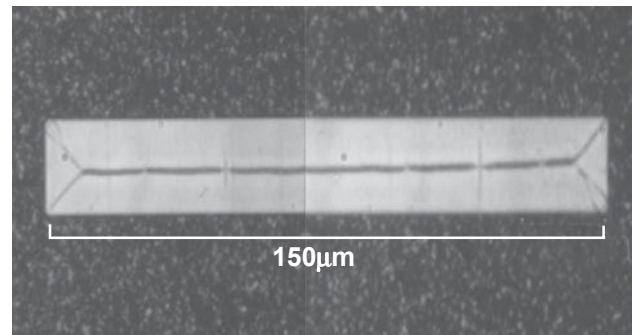


Magnetic domain of thin permalloy film of thickness 500Å observed using ferrofluid (400X magnification).

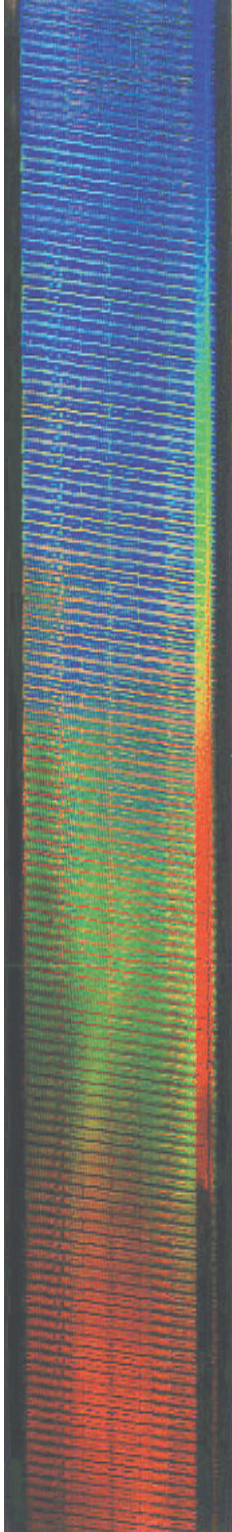


Even 20µm x 20µm closure domains are observed easily under 1000X magnification

##### Cross-tie wall



Fine detail such as the cross-tie wall can be clearly observed under 1000X magnification



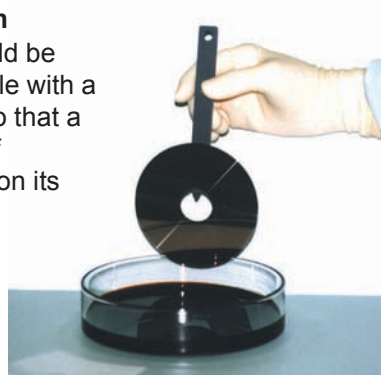
Magnetic domain of videotape under microscope

# Ferrofluid

## Usage

### Pattern recognition

The Ferrofluid should be applied to the sample with a glass rod or Q-tip so that a thin uniform layer of ferrofluid is formed on its surface. Alternatively, the tape or specimen can be dipped in the ferrofluid to achieve the same effect.



When the ferrofluid has evaporated, a microscope (100X) can be used to observe the domains. The light source should be at an angle of about 30-45° for best viewing results. An infrared lamp may be used to

accelerate the evaporation of the ferrofluid. In some applications, the domains can be viewed without the aid of a microscope.



The resolution of a domain pattern depends on the particle density in the ferrofluid. If necessary, the ferrofluid may be diluted with distilled water or an appropriate solvent to achieve the necessary resolution. To enhance the contrast of the pattern, a small external magnetic field may be applied to the specimen.

### Wetting Agent

Magnetic tapes and disks are generally coated with a thin layer of lubricating oil. The ferrofluid, therefore, may have a tendency to bead up on the surface. If this is the case, the addition of a wetting agent changes the surface tension of the ferrofluid, enabling it to spread uniformly. Only the necessary amount of ferrofluid needed for immediate use should be prepared.

### Storage

Due to the evaporative nature of water-based ferrofluid, it should be kept in a tightly closed bottle and stored at room temperature. Diluted ferrofluid should not be stored.

### Safety

Ferrofluid is not hazardous to the human body. It will, however, stain clothes and skin so protective clothing and gloves are recommended. In the case of eye contact, flush eyes with water for fifteen (15) minutes. In case of skin contact, first flush skin with plenty of water and then wash with water and a mild soap. Material Safety Data Sheets (MSDS) are supplied with the ferrofluids.

## Ordering Information

	Part Number	Saturation Magnetization	Viscosity
<b>Water based ferrofluids</b>			
EMG 308	89WA0600000	66 Gauss / 6.6mT	< 5cp / < 5mPa·s
EMG 408	89W0600000	66 Gauss / 6.6mT	< 5cp / < 5mPa·s
EMG 508	89X0600000	66 Gauss / 6.6mT	< 5cp / < 5mPa·s
EMG 707	89R1000000	110 Gauss / 11mT	< 5cp / < 5mPa·s
EMG 708	89R0600000	66 Gauss / 6.6mT	< 5cp / < 5mPa·s
EMG 807	89S1000000	110 Gauss / 11mT	< 5cp / < 5mPa·s
Wetting agent for water based fluids	89Z1000000	suitable for use with all water based fluids	
<b>Mineral oil based Ferrofluids</b>			
EMG 911	89U1000000	66 Gauss / 6.6mT	< 5cp / < 5mPa·s
Solvent for EMG 900 series ferrofluids	89Z5000000	suitable for use with all EMG 900 series ferrofluids	
<b>Domain detection kit</b>	88B3000003	includes 7 samples, wetting agent and solvent for EMG 911	
Special ferrofluids	A range of special and customer designed ferrofluids are available. Please call for details.		

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