Electrical, Magnetic and Optical Properties Characterization Laboratory (EMOL)

The magnetic properties of materials are mesured by using the Physical Properties Measurement System (PPMS) and Barkhausen-Noise Analysis Device in EMOL. Electrical properties are also measured by PPMS.

Color assesment is performed by Color Spectrophotometer.

High resolution sub-micron 3D topographical imaging at solid surfaces is performed by Atomic Force Microscopy (AFM).

1. Physical Properties Measurement System (PPMS)

To reach the cryogenic temperatures about to 2 K a closed-loop Helium system is used. The system with the super conducting magnet up to 5 Tesla makes it possible to do electrical and magnetic characterization measurements. Vibrating sample magnetometer (VSM) and electrical measurement probes enable magnetic hysteresis, AC susceptibility, resistivity and Hall Effect measurements.

Instrument: Cryogenic Limited PPMS

Specifications:

Magnet type: NbTi solenoid (swept and persistent mode)
Magnetic field range: up to ±5 Tesla
Sample temperature range: 2 K to 325 K
Typical cool down rate: 1 K/min
Maximum sample size: 10x10x1 mm

Measurement Options:

-Vibrating Sample Magnetometer (VSM)
-AC Susceptibility
-Resistivity
-Hall Effect

Sample Requirements:

Powder samples for the VSM and AC Susceptibility measurements must be minimum 300 mg.
Maximum sample size for the resistivity and Hall Effect measurements: 10x10x1 mm

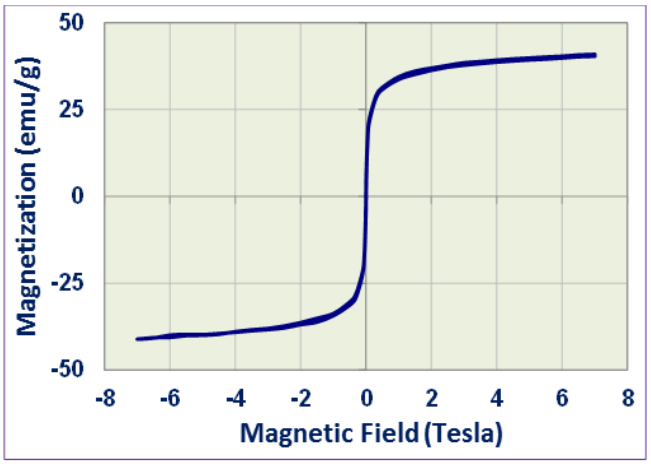

Figure 1. Magnetic hysteresis loops of magnetite (Fe_3O_4) nano particles

2. Barkhausen-Noise Analysis System

This device is used for evaluation of the state of residual stress in ferromagnetic materials. It controls to activate and detect the magnetoelastic signal. It energizes the sensors, process the signals and convert the measurement data into numerical read-out of stress and certain other units.

Instrument: Stress Tech Microscan 500-2

Specifications:

Measurement depth (in iron): 0.02 mm, and 0.2 mm
Total Signal Frequency Range: 3 kHz - 1000 kHz
Measurement Setup Parameters:

- Magnetizing Frequency: 1-1000 Hz
- Magnetizing Voltage: 0-20Vpp
- Sampling Frequency: 0.1- 5 MHz.
- Number of Bursts: 2-1000

Sample Requirements:

Samples should be ferromagnetic and have own references for comparison.

3. Atomic Force Microscopy (AFM)

AFM measures the mechanical properties of surfaces by topographical imaging at the nanoscale. It is used for revealing the topography, hardness and adhesion properties of surfaces. When required, surface magnetization and charge distribution can also be imaged at a similar lengthscale.

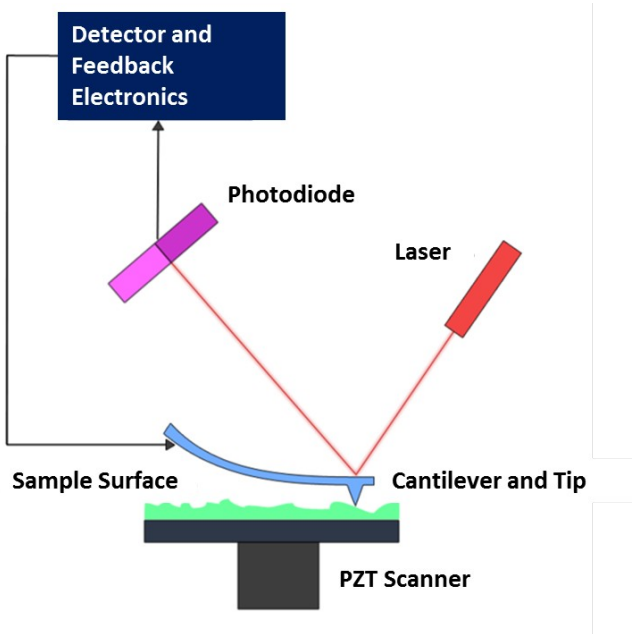

Figure 2. Schematic depiction of a typical AFM setup

AFM uses inter-atomic forces to map the surfaces in 3D. By raster-scanning an atomically sharp apex of a solid tip, it identifies the surface corrugation and converts into topographical information using color scale. When needed, position dependent height information can be rendered to appear in a 3D projection allowing for a realistic impression of the surface.

Scanning probe imaging can be performed in 3 different operation modes. These are: dynamic non-contact, dynamic contact (intermittent or tapping), and contact modes. In our laboratory, we mostly utilise the “tapping” and “contact” modes.

The surfaces to be imaged can be solid surfaces of metal, semiconductor, dielectric, bulk crystalline or amorphous materials as well as soft surfaces of polymer, nanotube, colloidal nanoparticle, graphene and organic and inorganic fiber materials of nanoscale structure. After the topographical imaging, the surface roughness can be calculated from a region of interest such as a rectangular area or along a line if required.

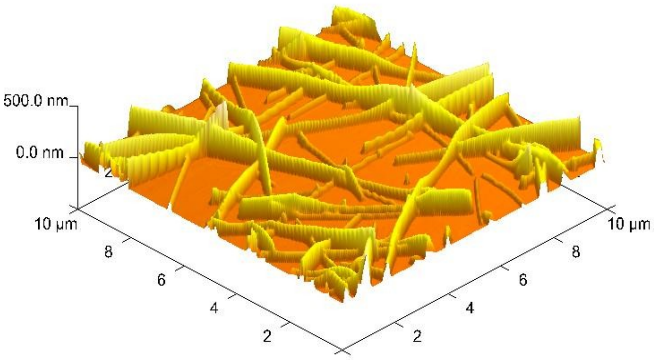

Figure 3. 3D AFM Image of Silver Nano-wires

Instrument: Veeco MultiMode

Sample Requirements:

Only solid sample substrates are suitable. Powder or adhesive samples are not suitable for AFM imaging. The sample surface to be scanned must be flat and horizontal; the sample must have a maximum height of 3 mm, and must fit inside a 15 mm diameter space. The surface roughness must be below 3 um for AFM to operate properly. Substrate Examples: Mica, quartz, glass microscope slide, polished Si wafer, PVC or similar polymer pieces.

4. Color Spectrophotometer

A spectrophotometer operates on a reflection based tecnique. It allows for identification of color by using CIE based color classification.

Instrument: Datacolor Mercury 2000

Specifications

- Light source: Pulsed Xenon
- Spectral range: 400-700nm
- Effective bandwidth/resolution: 10nm/2nm
- Measuring range: 0 to 200% reflectance

Sample requirements:

Reflection measurement surface must be flat and at least 6 mm diameter.

Contact Information

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