Light / Optical Microscopy (Metallography)

Instrumentation and Sample Preparation

Model:

- Nikon Epiphot Optical Microscope *(Figure 1)*
- The instrument uses light to study the microstructural properties of an alloy.

Sample Preparation:

1. Sample is cut to approximately 15 mm.

2. The cut specimen is mounted in Bakelite to allow for easier sample preparation. *(Figure 2)*

3. Sample surface is linished using a series of sandpaper – from 120 grit up to 1200 grit. *(Figure 3)*

4. The sample is then polished using a 6, 3 then 1-micron cloth and diamond paste – to polish the surface to a mirror finish.

5. Finally – the sample is etched using mineral acids to reveal the microstructure, which can be examined using light microscopy.

How does it work?

The Microscope:

Light is generated from a light source (bulb), where it is passed through a series of lenses and focussed on the surface of the sample. The light is reflected off the sample surface and into an eyepiece and/or camera. This reveals the surface microstructure where micrographs can be taken for quality control (QC) purposes. *(Figure 4)*

The use of an inverted microscope gives greater freedom to move and manipulate the sample to thoroughly investigate the microstructure.

Microstructural Assessment:

Typically, a sample is etched in a suitable etchant (e.g. nital, a mixture of nitric acid and alcohol). This reveals surface structure features e.g. grain boundaries (GB), non-metallic inclusions, precipitates etc. *(Figure 5a/b, Figure 6)*

Analysis can be done by using reference micrographs, graticules (eye-pieces) or using automated software.

What does it detect?

Microstructural Properties:

- Grain size
- Metallic phases and secondary phases
- Grain distribution
- Segregation
- Defects
- Inclusions
- Porosity
- The volume fraction of phases
- Case depth and surface features

In addition to these features, it can be used as a QC tool to compare to previous melts of an alloy – as the microstructure can affect macroscopic, physical, mechanical and magnetic properties hence overall alloy performance under specific conditions.

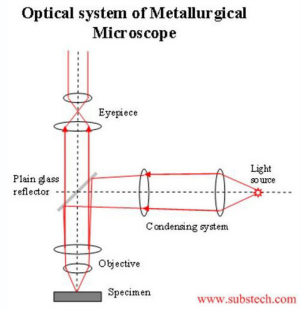

Figure 1: Nikon Epiphot Optical Metallurgical Microscope

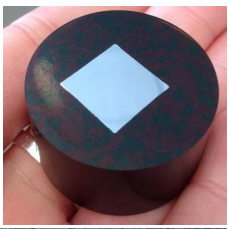

Figure 2: A Mounted and Polished Metallographic Sample

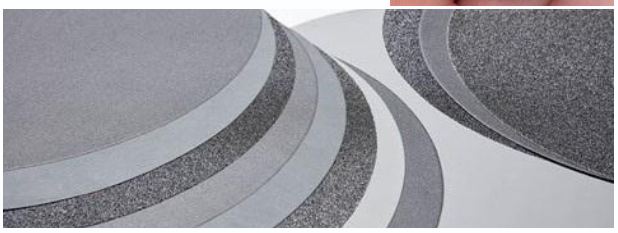

Figure 3: Silicon Carbide Paper (for linishing metallographic samples)

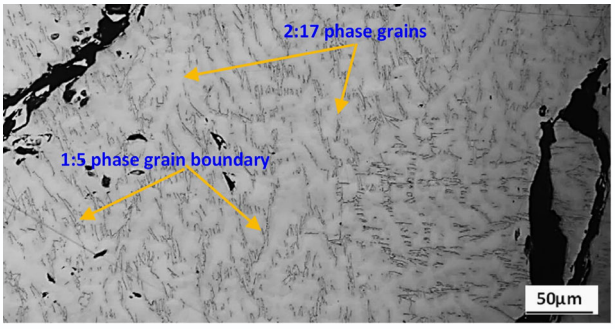

Figure 4: Microstructure of Sm2Co17 (x10 magnification)

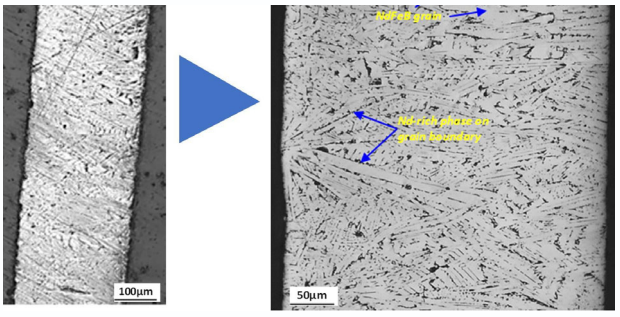

Figure 5a *Figure 5b*

Cross-section of Strip Cast NdFeB Flake micrographs (x10 and x20 magnification)

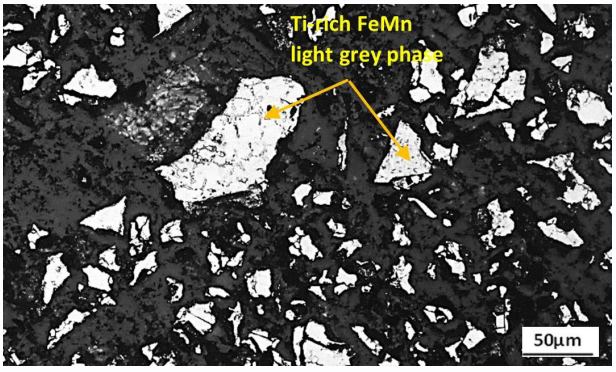

Figure 6: Microstructure of TiFeMn Powder Alloy