GRAIN SIZE CHARACTERIZATION OF AL ALLOYS
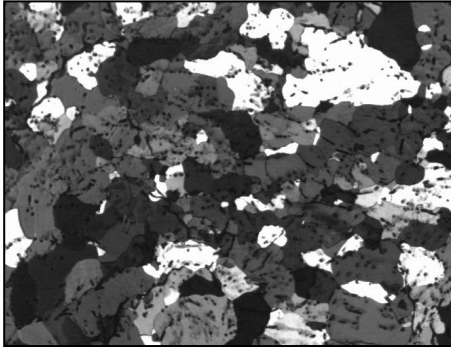

Figure 1: Original image.
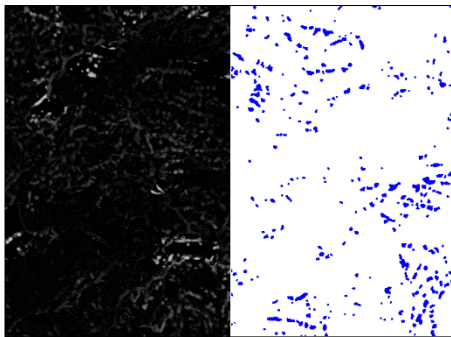

Figure 2a: Black Top Hat of the original image.

Figure 2b: Precipitates as measured.
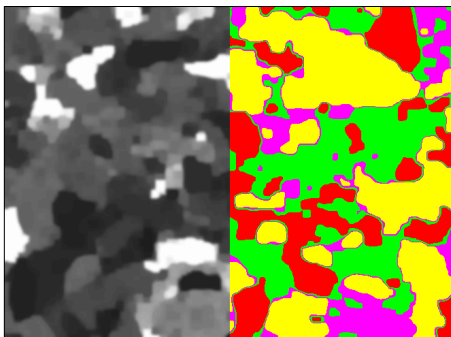
Sample Description

Seven specimens of anodized aluminum. Three samples of Al+1.0 Si, two of Al+1.0 Si+0.5 Cu and two others of Al+0.5Cu.

Purpose of Analysis

Demonstrate the ability of the Clemex Vision image analysis system to discriminate and measure all grains.

Procedure

The original image (Figure 1) is analyzed under a polarized light on a 9 fields pattern. A Guard Frame was set to the approximate object size. Figure 2a shows a gray transformation that isolates all small black particles. Precipitates are binarized and transformed into blue bitplane in Figure 2b. A length measurement was then performed on the resulting bitplane. The original image was brought back to perform the grain size analysis. Certain gray operations are applied. Grains with different gray levels are assigned to different bitplanes as shown in Figures 3a and 3b. A set of binary operations are then used to separate typical grains in Figure 4a. Rough grains are isolated and subdivided as can be seen in Figure 4b.

Equipment

Image Analysis System:	Clemex Vision PE
Microscope:	Nikon Epiphot 200
Camera:	Sony XC-77CE B&W
Magnification:	40X
Stage:	Marzhauser EK8B-S1

Figure 3a: Gray pixels are spread over the black or white areas.

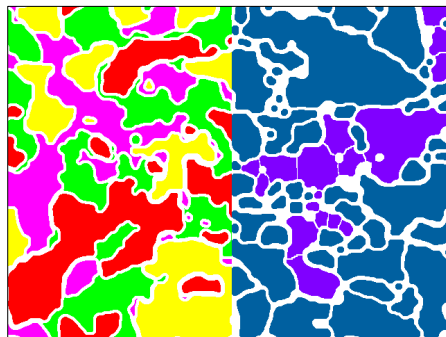*Figure 3b: Binarization by Gray Threshold creates 4 different bitplanes.*

Figure 4a: Preliminary grain discrimination

Figure 4b: Rough grains are isolated and subdivided.

Results

Grain size measurements (ASTM E112) by objects and by fields were then performed. The Process Frame was set according to the Guard Frame prior to field measurements to avoid processing certain portions of the image twice. Figure 5 shows a grain size distribution.
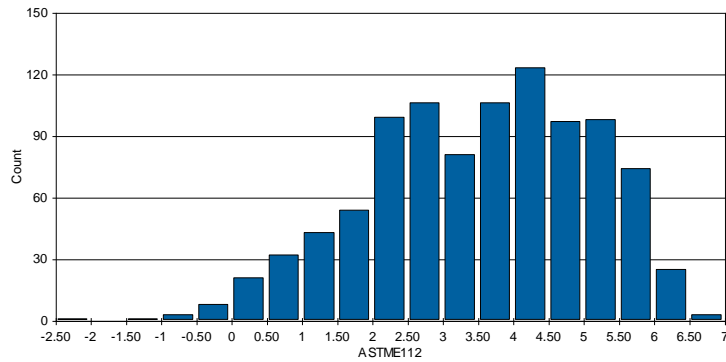

Figure 5: *Grain size distribution according to ASTM E112.*

	Grain Size by object	Grain Size by field		Length Precipitates
Minimum	-2.05	1.77	***Minimum***	3.0
Maximum	6.67	3.09	***Maximum***	129.9
Adapted Average*	3.09	2.67	***Average***	23.5
			Standard Deviation	14.2

*The logarithm is subtracted before the average is calculated, and then added to the results.