Microstructure Image Analyzing System

A. Hardware

A.1 Digital Color Camera (5 Mpixel)

Features:

- USB 2.0 interface (up to 480 Mbit/s)
- 8 Mpixels on-board memory for secure image transmission
- Micro-PLC for real-time sequencing (HRTC)
- Digital I/O – 1/1 opto-isolated
- Horizontal and vertical average binning
- Automatic gain control (AGC)
- Automatic exposure control (AEC)

Sr. No.	Description	Technical Specification
1	Image Sensor	**1 / 2.5"** type CMOS
2	Effective picture elements	2592 x 1944 (H x V)
3	Maximum Frame Rate	5.8 at high resolution
4	Pixel Size	2.2 X 2.2
5	Shutter Type	Rolling / Global reset
6	ADC resolution / output	10 bit → 10 / 8 bit
7	SNR	>38 dB
8	Exposure Time	10 ms – 1 s

A.2 Camera adapter

Specially designed Camera adapter as per microscope photography port

B. Software

B.1 Grain size analysis

Measurement by 2 methods

a. Intercept Method (Manual / Automatic mode)

- Facility to select number and orientation of linear test lines
- Facility to select circular test lines
- Facility for Angled (45 deg and 135 deg) test line for anisotropic and non-equiaxed grains analysis
- Facility to select minimum number of intercept lines depending upon number of intercepts found
- Facility to find intercept length and ASTM Grain No. for individual grains

b. Planemetric Method

- Facility for selection of region of interest for planimetric method
- Color coding of grains as per ASTM size number
- Grain size distribution with graphical plot and identification of largest grain available

- <u>Auto grain boundary tracing and enhancing feature for automatic analysis</u>
- Pop-up alert for insufficient intercepts or grains in test region

B.2 Phase Analysis

- Automatic thresholding of the image
- Pick & place of gray value for smart selection of a phase of interest from rest of the matrix
- Histogram, Color coding for independent phases
- Facility for selection of region of interest

B.3 Inclusion Analysis

- Separation and rating as per ASTM E45, E1122
- Showcase windows for all the separated and rated inclusions for cross verification with standard inclusion chart
- Separation of superimposed inclusions (Sulphides superimposed over oxides) and rating them independently
- Provision to compile results for number of fields of view as per various standards

B.4 Cast Iron Analysis

a. Nodular Cast Iron

- Class separation of nodules as per shape factor and estimation of percentage nodularity (Facility to set the limits of class, if required)
- Size classification as per standard ASTM A 247 and estimation of percentage of each class
- Size threshold facility to filtrate non-graphite particles
- Phase analysis with facility to omit or consider graphite nodules

b. Gray Cast Iron

- Size classification as per ASTM A247
- Identification of largest flake in the field of view and reporting the respective size class

B.5 Aluminum and alloys Analysis

- Percentage porosity estimation
- Geometrical parameters such as length, diameter, perimeter estimation of Silicon cuboid particles
- Dendritic Arm Spacing estimation

B.6 Banding Analysis

- Anisotropy Index and Degree of Orientation estimation
- Thickness of banding and inter-band spacing measurement

B.7 Decarburization depth Analysis

- Facility for tracing decarb interface and selection of number of readings for better averaging

B.8 2D analysis of features of interest as per following

- Object counting
- Distance between any two points
- Angle between any two edges

- Area Measurement
- Circle – radius, perimeter, circularity percentage measurement
- Rectangle measurement
- Irregular shape measurement

These analyses are used in various applications such as estimation of case hardening layer, decarb layer, interlamellar distance, particle count and size, weld penetration depth and other weld parameters etc.

B.9 Additional features

- All the results can be reported in units like micron, mm, cm, inch etc.
- Quick Calibration attachment system with freedom for adding additional magnifications

B.10 Planar Stitching in X and Y direction

One can stitch multiple images captured randomly in X and Y directions to offer complete presentation of interested area in single frame

B.11 Z stacking / Extended depth of focus

- Obtaining Fully focused image by smart image blending of partially focused images captured at different Z planes.
- Extended depth of focus can also be done on-line without storing of images by just fine focussing the image gradually.

B.12 Report generation in MS-Excel format

Desktop Computer to be arranged by Customer for the system

Minimum specifications required are : Processor - Intel® Core™ i3or better , Memory - 4 GB DDR3, Hard-drive - SATA (7200 rpm) 500 GB, USB 2.0 ports , DVD writer, keyboard, mouse, LED monitor 18.5” or better.